



Research Paper

## The Availability and Quality of School buildings in Egypt

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### ABSTRACT

The development of school building in Egypt occupies a high priority in society's interests, despite the diversity of priority issues. This study aims to provide a background on Egyptian thought development in school construction and maintenance from 1990 to 2020. In this study, we used the descriptive method to collect and interpret data. This method aims to describe an object of phenomena after data collection, analyze it, identify the conditions and relationships between variables, and monitor the challenges arising from Egypt's educational system's problems. The analyses revolve around two main pillars: availability and quality. It presents the following domains: 1) Introducing school buildings in Egypt, 2) Analyzing the current situation from availability to quality, 3) The requirements of technological development and education technology, 4) The spending on pre-university education, 5) The influencing and consequences factors. In conclusion, many challenges are facing the availability and quality of the school buildings in the various education stage, such as; a) the steady increase in the population, b) the increased burden on the demand for education, c) inadequate school supplies, d) the lack of technology infrastructure in schools, e) The hamble of social justice and equal opportunities, f)The lack of land and poor planning, g) the lack of availability leads to leakage and failure.

**KEYWORDS:** School building, Class density, Student Enrollment, Educational Policy, Quality Education

Received 26 April, 2021; Revised: 08 May, 2021; Accepted 10 May, 2021 © The author(s) 2021.  
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### I. INTRODUCTION

Educational buildings are essential as public property accomplished by the State in its development plans (Zaki Ewiss et al., 2019). Its appearance must preserve the academic environment of the student. These settings help the student complete his upbringing, direct his behaviour, and awareness of the meanings of goodness and beauty. It develops his feelings of belonging, strengthens his association with those achievements, and pushes him to preserve them and contribute effectively to their appearance. It is worth mentioning that maintaining educational facilities and ensuring their safety and protection from tampering and damage has become a duty and an essential requirement (Fisher, 2001). The school building is crucial in the implementation and success of educational plans in all its dimensions. This building represents a component of the infrastructure underlying the comprehensive development plans, designed following educational specifications, and contains the necessary facilities, equipment, and tools to implement educational strategies (Martin, 1999).

In 2015, Abdelhamid et al. developed a Strategic Asset Management Framework for educational buildings in Egypt. Their study has based on the General Authority for Educational Buildings (GAEB) reports. The GAEB represents the most prominent governmental organization responsible for planning, operating, and maintaining schools in Egypt.

The importance of the academic building is due to the following (Barret et al., 2015 and Estin, 1997):

- The school building helps to achieve academic goals in the best way and the most successful educational means.
- The model-designed educational building effectively helps nurture generations who can create a renaissance society.
- The educational building design with typical specifications provides students with an atmosphere of tranquillity and psychological comfort. It helps in their development in an integrated way psychologically, physically, skill, behaviour, and social.
- The educational building promotes students' delivery of information in the easiest and latest scientific methods and equipment.

The philosophy of designing sound educational institutions is based on providing a school building at the highest design level. All the necessary spatial elements are available for the educational process and complementary activities, taking into account the correct functional, environmental, and academic criteria stemming from urban and rural communities' climatic parameters. Egyptian society's educational values provide security, safety, and aesthetic elements that develop students' aesthetic sense. School buildings' sound design philosophy maintains the technical condition by implementing an integrated strategy for maintaining educational establishments and their proper equipment, machinery, and equipment (Martin, 1999, and Estin, 1997). Also, sound educational institutions' design philosophy has based on equipping academic buildings with the latest educational means. The scientific and practical equipment is essential to upgrade the educational level at all ladder stages. To develop and implement a plan for the total absorption of students at all age levels in the academic ladder, one should consider the population growth. To accommodate the requirements of improving the educational service by abolishing schools' second shift period, reducing class densities, and replacing dilapidated school buildings. It prompted attention to preparing the necessary studies to develop the standards and specifications of educational establishments' design following the advanced educational methods and curricula. In Egypt, one should consider the diversity of local environments between urban and rural areas under each climatic region's natural conditions and the design of various school buildings for different stages of education and specialized types. The application of standards and design specifications developed through studies to achieve flexibility in understanding the variables and work on constructing educational buildings in implementing the plan of needs developed and approved. From this point of view, the General Authority for Educational Buildings (GAEB) has established by the President of the Republic's decision No. 448 of 1988 (East Laws Network, 2017). The aims were to establish the educational buildings, develop standard specifications of their design, and set building regulations and rules. The development plan's objectives had to consider all the necessary conditions to maintain the school buildings. The Authority works with a decentralized and centralized system to achieve the State's purposes in the field of academic buildings, and it is not central through the branches of the Authority in the provinces (27 departments) to achieve the following:

- Coordinating the political and executive agencies through the authority branch, which has independent technical and administrative capabilities that can supervise the work appropriately.
- Studying the demands and needs in all provinces, following the State's needs and priorities, while maintaining standards, policy, available funding, and preferences.
- Supervising the implementation of the works and the application of quality systems.
- Taking measures for the exchange of money on the business and following the approved plan.

The Central Agency for Public Mobilisation and Statistics (CAPMAS-2012) also indicates that the State has been able to accommodate more than 90% of the primary education age population. Due to the quantitative expansion in education, the Ministry has resorted to using school buildings over two shifts or renting school buildings with no basic educational requirements. Thus, the significant increase in the number of students enrolled in different education levels over the past decades has resulted in increased efforts not only on the quantum side but also on quality, which represents attempts to achieve the desired goals.

## **II. THE FOUNDATIONS AND CRITERIA FOR PLANNING EDUCATIONAL BUILDINGS**

There is no doubt that school buildings are different from other administrative, industrial, and residential buildings because of their different purpose. Designing school buildings goes through many stages, starting with identifying the community and learners' needs, collecting data on the essential inputs for them, and determining their educational and architectural requirements and their criteria. Translating them into functional and educational spaces and developing various design concepts, and judging the design proposed by educators and architects. Therefore, the school buildings should take into particular account standards when designed. In the school building's general planning, the school's location is choosing to be as close as possible to the residential neighbourhood. The school building's technical needs require achieving excellent & adequate ventilation within the classroom, the regular distribution of proper availability of the necessary sanitary equipment (GAEB, 2014). The school's design criteria include choosing the appropriate style for each stage of education, identifying the various areas of educational spaces in terms of the number of pupils, teachers, and administrators. The supplementary areas of services and facilities distributing the total area to the number of pupils are studying. Finally, the criteria for equipment must be of materials that are easy to decipher, install, unrestrained, allow for more than one use, and be compatible with the pupil's physiological characteristics.

There is an importance to the physical environment in which pupils learn. Both pupils and teachers must have a safe and healthy school environment and have spaces designed to support the preferred educational method. Schools are not just buildings but learning centres. Therefore, there is a need to improve, locate, build, and maintain these schools in light of contemporary global trends and standards, taking into account Egypt's

economic potential (GAUP, 2014). Figure 1 illustrates the factors influencing the planning and design of school buildings. Among the foundations of the planning of educational facilities, we have the following:

- State policy in education, whether the current policy or the expected development of these policies, in different levels of education and its association with the age groups, type of education, and the extent of the State's interest in specific disciplines.
- The set of foundations, whether the demographic, geographical, and environmental foundations, economic cost, or the need for the exceptional quality of education to reach the appropriate planning and design of the educational building and its statement as follows:
  - ❖ Natural resources/industrial and agricultural development:  
Weather conditions and the site's nature affect the design in terms of the building's orientation and identifying the buildings' appropriate and heights. Also, placing the proper materials in the school building and considering whether the earthquake area can develop the right foundations.
  - ❖ The population's distribution and growth affect each school's needs, the class densities, and the stage's quality.
  - ❖ The budget had carried out through the national account. The school's level is determined in terms of finishing, the number of classes, additional services included in the design program, the number of building roles, the number of schools created according to the funding available, calculating the student's cost from the service, etc.)

The schedule/teachers, the hours of study/spaces available determine the number of rooms in each educational building for a particular activity to accommodate the school building's service schedule.

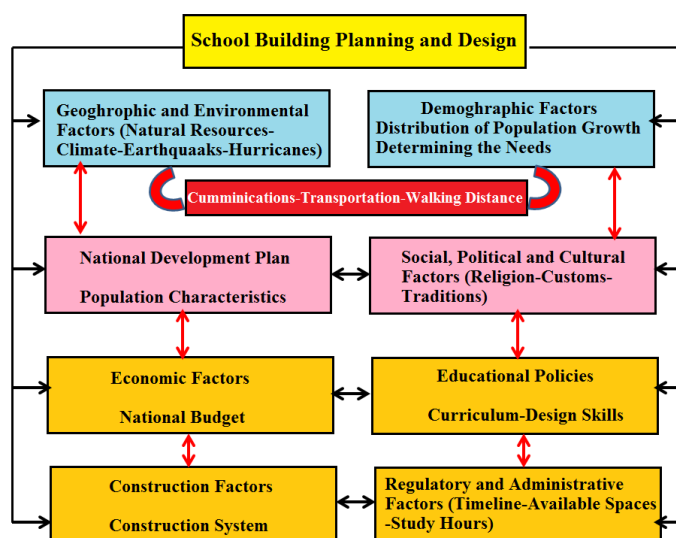


Figure 1: The factors influencing the planning and design of school buildings

The general requirements for school buildings and their services have specified as follows (GAUP, 2014):

- The idea of an integrated educational complexes system includes more than one academic stage introduced to save expenditures in remote areas without compromising the rates and purchase a stake of all.
- The flat site is determined according to the educational stage's needs and the academic plan's program. It means that the school's total area includes the location of blocks and buildings for the ground floor plus the areas of yards, playgrounds, green areas, and spaces between buildings.

Two entrances are required (minimum) regardless of the number of streets surrounding the site. There are also special requirements according to the type of learning path (general/technical/agricultural/industrial/commercial/ hotel) and requirements for schools with special needs.

### III. ANALYSIS OF THE CURRENT SITUATION FROM AVAILABILITY TO QUALITY

The development of educational buildings has addressed the treatment of both availability and quality. The extent to which the system can provide equal opportunities for the population of academic age to join the educational system. Regarding the economic and social level or any other differences, Egyptian governments

have targeted successive priorities over the past periods. For example, remedy the obstacles encountered, such as the earthquake of the 1990s and the steady increase in the population.

As for quality, the concept of quality of education began to be clear with the beginning of the basic education improvement program, funded in part by the World Bank and the European Union. This fund increased with the beginning of the new millennium, relying on a fundamental pillar of educational quality, namely the Declaration of National Standards for Education in Egypt in 2003 (OECD, 2015). In 2004, the concept of school reform had introduced several pilot projects according to the national standards. Until establishing the National Authority to ensure the quality of education and accreditation, a quality department was established in the Ministry of Education Office, followed by corresponding departments and educational departments. Nearly 3,000 schools were rehabilitated and accredited. Over the past 15 years, Egypt's education system has evolved into specific historical shifts of availability and quality. However, quality is now at the center of the development of the educational process. It is worth noting that the separation of quality and availability is a theoretical chapter for analysis and resource allocation. Access without quality does not mean much from an educational perspective (MoE, 2014). One of the quality indicators in education is to reduce classroom density by increasing the number of equipped schools.

The school buildings must have the appropriate specifications, facilities for educational activities, and a sufficient number of such structures. The steady population increase has placed an increasing burden on the demand for education, leading to a trend of quantitative expansion at the expense of spending on quality standards, reflected in high classroom density, multiple school periods, and insufficient school supplies. Also, we noted that schools operating for more than one shift of learning time are concentrated in big cities' popular and poor neighbourhoods, reflecting the educational process's unfairness (NCSCR, 2002).

The following is a detailed report of availability and quality at the level of buildings at different educational stages.

### 3.1 Availability

In the Index Mundi (2020), The demographic profile of Egypt showed a steady increase in the population (Index Mundi, 2020); the data concerning the school's number, class density, and student's number reported in the Campas annual report (CAPMAS, 1985-2020).

Figure 2 shows the evolution of school numbers from 1985 to 2019 [11-20]. The number of public schools increased from about 17,300 in 1985 by 186 % to 32,300 in 2010 [CAPMAS, 1985 and CAPMAS, 2010]. In 2018/2019, the total public school numbers are 47,043 schools (CAPMAS, 2019). This number increased by 2.5 % compared with the school number of 45,846 in 2017/2018 (CAPMAS, 2018). The educational building authority supervises schools' construction and maintenance. The Authority has drawn up plans to build 7,500 schools for various educational stages during the five-year plan (92/1993 to 96/97) at a rate of 1,500 schools per year and plans to renovate and maintain old school buildings (NCERD, 2001).

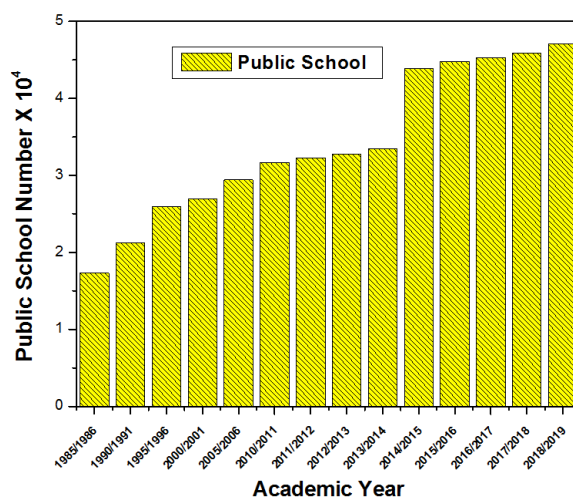


Figure 2: The development of the public School numbers from 1985 to 2019

Since the early 1990s, the Government has considered Egypt's education as the first national project. It was evident in those efforts to contain the earthquake that struck Egypt in 1992 (NCERD, 2001). It caused extensive damage to school buildings, leaving a large number of them unusable and unsafe. As a result, 1,343 schools were closed for reconstruction, and 2,546 schools in need of restoration have cracked. The achievements were in numbers in the early 1990s to address the problem (as illustrated by the quantitative expansion of school buildings, efforts had made to compensate for the losses caused by this earthquake, a

budget had allocated to provide infrastructure to provide education, with an estimated 240% increase in the education budget during the 1990s. Statistics show that more than 14,000 schools have established between 1992 and 2005, more than double the number of schools built over the past ten years (UNHDA, 1992).

From 2011 to 2016, ministerial changes in educational policies, creating instability, which was seen as a transition for change and stability to meet the challenges and demands of the revolution of January 25, 2011 (social justice, political freedom, social and economic security for the people). Although the number of schools at all levels has increased, we noticed that the class's density increased.

From Figure 1, it is clear that the State is engaging in constructing educational buildings, their numbers increasing annually. As part of the State's interest in academic buildings, the strategic plan for pre-university education (2007/2008-2011/2012) identified priority education reform programs (MOE, 2007). It developed twelve programs and their expected outcomes, including the school building development and maintenance program. The "School Building and Maintenance Development Program" aims to build the necessary numbers of classrooms, decentralize school building and maintenance systems to ensure fair availability and quality. And to suit the school building for different geographical environments so that the school can be a centre of excellence for education and culture dissemination in its communities.

The procedural objectives were mainly to improve and develop school planning and construction procedures and provide school buildings for all educational needs. The strategic plan for pre-university education (2014-2030) was the national project of Egypt. It included several governing strategies directed at the activities of the program concerning educational buildings as follows (MoE, 2014):

- Providing integrated opportunities to accommodate and educate all children aged 5-18 and improve the school's ability to retain them and reduce their leakage.
- Finding non-traditional treatments to address the severe inadequacy of school buildings and equipment and reducing the high density of classrooms, funding, and land.
- Reconsidering the sports, cultural, social, and artistic activities at various levels of education, and considering the existence of stadiums, theatres, libraries, and halls equipped for skills development in multiple fields as equally important with the construction of classrooms and research laboratories (alternatives).
- Developing a learning environment and providing them with the technologies required to improve education in a highly technical learning environment starting at the primary level by enhancing its technological component.
- Despite these efforts, invalid school buildings account for 23.8% of all school buildings distributed across the governorates.

Table 1 shows the high percentage of weak buildings in Upper Egypt and some border governorates. As for the border provinces, the highest proportion of the State is Matrouh province. As for the urban governorates, the overall average is 16%, which is the best average. The lowest number of invalid buildings of 15.3% had located in Cairo due to some of its neighbourhoods' care. Thus, despite efforts to construct new educational buildings so that all children can be made available and pupils are accommodating, the rehabilitation and restoration of other school buildings are a burden. 2007-2012 prompted a strategic plan, including the School Building Maintenance Programme. However, the buildings' maintenance continues to be a burden on the Ministry. The Building Authority's Report indicates the current status of school buildings. According to the State of school buildings, 1,361 public schools had closed, and 815 schools had partially closed. Twenty-five thousand five hundred fifty-four buildings were under maintenance, representing 8.1% (MoE, 2014).

In the field of school maintenance and development, since its inception, the Authority has carried out substantial renovations of educational buildings following a plan at the highest operational and administrative level for maintenance and restoration work at a rate ranging from 7% to 10% of the total educational buildings annually (GAEB, 2014). In 2015, GAEB reported on the Quality Education Support Program. This program has been introduced to support Egypt's "Pre-University Education National Strategic Plan 2007/8 – 2011/12. It was strengthening the performance of the Government's decentralization policy. The program's concept based on the Ministry of Education's (MoE) explicit request to create a more comprehensive approach than in previous program phases and to combine the provision of physical infrastructure (Investment Component) with a Social Component (provided by the International Consultant's Social Experts and NGOs) aiming at improving the quality of education as well as the learning environment. It mentioned that elementary schools could design various sizes, configurations, and layouts depending on the school district and the program. GAEB, 2015).

According to the decentralization policy, the Government has also implemented the national project for schools' maintenance and development. This project has transferred to education directorates.

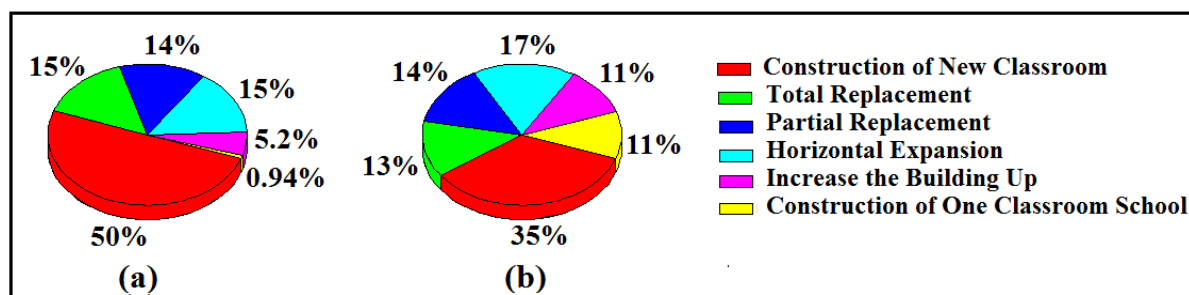
Figure 3a shows the achievement in public schools' construction since establishing the General Authority for Educational Building in 1988. In comparison, Figure 3b shows the implemented part of developing the classroom numbers from 1990 to 2019 (CAPMA, 1990-2020). In Figure 4, we present the

school's development, including the class and the pupils' numbers from 2014 to 2019 CAPMAS, 2014-2020). The highest achievement was in the kindergarten and primary schools. Table 2 represents the latest achievement of 2018/2019 is compared between the public and private. The results showed that the contribution of the private sector's investment in education is low.

**Table 1: Distribution of invalid school buildings\***

The province	Percentage of invalid buildings	The province	Percentage of invalid buildings
Cairo	15.3%	Red Sea	18.9%
Alexandria	16%	New Valley	18.4%
Port Said	19%	Matrouh	63.6%
Suez	22.8%	North Sinai	44.6%
		South Sinai	3.20%
Average urban governorates	16%	Average border provinces	35.7%
Damietta	22.7%	Giza	21%
Daqahliya	21%	Beni Suef	22.5%
El-Sharqia	16.7%	Fayoum	17.1%
Al-Qalyubia	13.7%	Minia	35.1%
Kafr al-Sheikh	22.9%	Assiut	10.3%
Al-Gharbia	21.9%	Sohag	27.5%
Minoufia	28.4%	Qena	29.4%
Ismailia	16.9%	Aswan	44.7%
Average maritime provinces	22%	Average tribal governorates	28.4%
Average Republic			23.8%

\*[Source: CAPMAS, 2020].



**Figure 3: a) Achievements of buildings constructed since the Authority's establishment, b) What was implemented from 1990 to 2019 as part of the classrooms' development [Source: TheGeneral Authority for Education Buildings (GAEB, 2014)].**

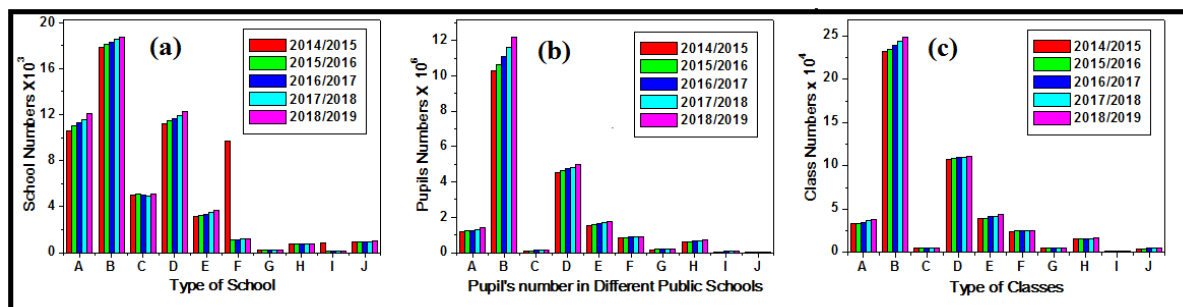
**Table 2: The school, class, and pupil numbers in public and private schools in the year 2018/2019**

School	School's Number	Class's Number	Pupil's Number
Public	47,043	429,884	20,121,329
Private	8,171	70,284	2,332,052
(Private/Public)%	1.49%	16.3%	10.4%
Total	55,0168	500,168	22,453,381

### 3.1.1 Availability and absorption

The increase in school numbers has increased children's primary education enrollment rates concerning the availability and total pupil absorption. From Table 3, the enrolment rates in primary education have approached global rates. In 1985, an education policy aimed to gradually increase the educational system's capacity to accommodate appropriate educational conditions and strategies to achieve the principle of democracy of education and equal opportunities. To accomplish this, the Ministry of Education adopted a set of strategic directions, including infrastructure and mechanisms capable of implementing. According to the Ministry of education statistics, the primary level's absorption rate increased from 2002 to 2015. The dropout rate in primary education decreased to 0.87% and in 1991/92 was 3.85%. Table 4 illustrates the absorption rate

calculated during the transition between education stages: primary, preparatory, and secondary. It is traced by comparing the numbers of enrollees in the first grade at each level.



**Figure 4: The development of a) School numbers, c) the pupil's number, and b) class's number, schools in the period from 2014 to 2019. A: Kindergarten, B: Primary schools, C: Community schools, D: Preparator schools, E: General Secondary Schools, F: Industrial Secondary schools, G: Agriculture Schools, H: Commerce secondary schools, I: Hotel Secondary schools, J: Special schools. [Source: (CAPMAS, 2014-2019)].**

**Table 3: Percentage of pupils enrolled in the first grade of primary school\***

Year	Percentage of pupils enrollment	Year	Percentage of pupils enrollment
1988/1989	96.4%	2008/2009	82.4%
1989/1990	96.5%	2009/2010	82%
1990/1991	97%	2010/2011	77.8%
1992/1993	98.9%	2011/2012	85.15
2001/2002	91.9%	2009/2010	82%
2007/2008	85.1%		

\*[CAPMAS, 1990-1993, CAPMAS, 2002, CAPMAS, 2008-2010]

### 3.1.2 Availability and equal opportunity

Regarding availability and equal opportunities, the females' dropout rate has dropped to (0.61%) in proper education between males and females. In 1991/1992 it was 6.5%, adequate and appropriate educational opportunities were provided. From 1991/1992 to 2001/02, female education in the same period was 20.9%.

The education policy for pre-university education focused on providing and achieving equal educational opportunities through the school building, child care, children with special needs, girls, literacy, and the adoption of non-traditional methods to activate community participation. By examining the statistical indicators of the number of schools and classes, the availability component can be presented in educational peace programs as follows:

#### 3.1.2.1 Availability in kindergartens

The Strategic Plan for Pre-University Education Reform 2007/08-2011/2012, early childhood development was one priority (MoE, 2014). The aims are strengthening the infrastructure of education technology, the interest in mobilizing all efforts in early childhood care, and supporting the Egyptian child's abilities. The tools of the era of science and technology led the children to interact with the third millennium's challenges and provide them with the capabilities and experience to help them compete. In the decade 2000/2010 was announced a contract for the protection and care of the Egyptian child. The minister established the training and educational centres for kindergarten teachers. The Government's commitment to developing the economy is a crucial factor. Only a tiny percentage of children have expected to enrol in this stage. In 2005/06, the total enrolment rate in kindergarten in the age group 4-5 was 1.18%. This value is weak compared to countries with an economic situation similar to Egypt. The Development of Education in Egypt came in the years 2007-2012 focuses on increasing the enrolment rate of children in kindergarten to 60% by 2012" (Strategic Plan for Pre-University Education MOE (2007). However, this goal of the strategy and the enrolment rate did not achieve.

According to the Strategic Plan for Pre-University Education (2014-2030), the number of kindergarten-age children enrolled in kindergarten sits at 423,000, representing 22.6% of the number of children aged five

years in 2012/2013. The number of kindergarten-age populations enrolled in primary school is 30.8%, with no difference between girls and boys. These percentages are still far from what the Government set out in the previous strategic plan 2007-2012, or what the Government is targeting is a 50% enrolment rate (MoE, 2014).

It is worth mentioning that there is a continuous growth in the number of children registered, with the growth rate recorded from 2004 to 2013. More than 8% exceeding the demographic change recorded for the 4-5 age group, which was in the range of 16.1% (MoE, 2014). During the 2007-2012 plan years, the strategic's quantitative outlook to reach the total enrollment rate to 60% in the 4-5 year age group was to build 22,100 classes for kindergartens with government support (MoE, 2014). Despite the objective of the Strategic Plan for Pre-University Education, 2007-2012, the statistical data of the Ministry of Education showed that 20167 has built. It means that the percentage achieved in the light of this plan was 91.25%. Figure 4b shows the development of the numbers of classes constructed during 2014-2019.

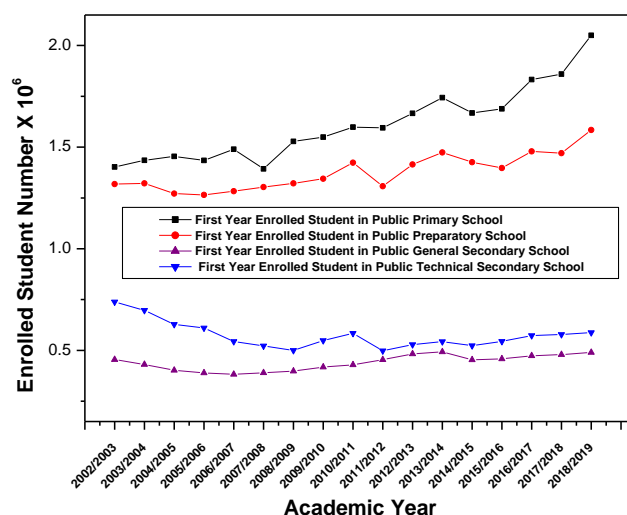


Figure 5: The pupil's number enrolled in the first grade in primary, preparatory general, secondary, and technical secondary schools from 2002 to 2019. [Source: Capmas's annual reports]

Table 4: The pupils' rate enrolled in the first grade for both the preparatory and secondary school.

Year	2005/2006	2008/2009	2011/2012	2014/2015	2017/2018
The absorption rate in Preparatory Schools	-	94.25%	91.1%	100%	99.86%
The absorption rate in Secondary Schools	75.8%	71%	72%	81.7%	79%

\*[Source: Capmas's annual report]

### 3.1.2.2 Access to the primary education cycle

Despite the free and compulsory nature of primary education in Egypt, the 1981 Law of 139, requiring the guardian to send his son or daughter to school (MoE, 1981). However, education is accessible under the 1953 Constitution, which stipulates that Egypt's education should be accessible in all stages, from primary education to university. Figure 4 shows the growth in the number of schools enrolled in primary education from 2007 to 2012. Primary education statistics in 2012/13 indicate that the number of enrolments is close to 11 million, and girls account for 49% of the enrolment. It is worth mentioning that the net absorption rate (Government and private) increased to 85.1%, an increase of 7.3% over 2011/12, and may be due to the low rate in 2011/12 due to Egypt's exceptional circumstances after the January 2011 revolution (MoE, 2007).

### 3.1.2.3 Access to the preparatory education workshop

Figure 5 illustrates the pupil's number enrolled in the first grade in primary, preparatory, general secondary, and technical secondary schools from 2002 to 2019. It is clear that absorption ratios in preparatory schools slightly increased, reducing dropout rates over the last five years. The State had interested in making preparatory education available to both boys and girls for the age group (12-14 years) by 2015 (MoE, 2014).



### 3.1.2.4 Access to secondary education

By tracking the development of government education at the secondary education level, the number of secondary school enrolments in 2012/13 exceeded the number of enrolled at the beginning of the previous plan in 2006/07, up to 30%, indicating that the turnout for general secondary education was increasing (see Figure 5).

Technical industrial, agricultural, and commercial schools have two types of programs, a regular three-year plan, and a five-year extension. The hotel technical education begins in 2011/2012.

The number of students enrolled in secondary education has declined compared to those enrolled in general secondary education. Still, by the beginning of the 1980s, the number of enrolments in technical secondary education had begun to increase compared to those enrolled in general secondary education. Figure 5c shows the high proportion of technical education enrollment, indicating expanding the preparatory school graduates' selection opportunities.

As for the quantitative development of the educational process dimensions with industrial technical education, the statistical data indicates the growth of school numbers with industrial education. It confirms a steady rise in the number of schools and reflects the State's interest in industrial education, namely, an increase in industrial schools. From Figure 5, it is clear that the number of schools has decreased in some years, which confirms that there is a policy towards reducing some commercial education schools. There may be a trend to convert them to the general secondary school. In Table 5, we collect the industrial, commerce, agricultural, and hotel technical secondary schools' statistical data from 2002-2017.

We noticed a steady rise in school numbers of agricultural technical schools, reflecting the State's interest in agricultural education and increasing farm schools. Also, many schools have been established in the reclaimed areas to serve these areas and graduate technicians working in various agricultural fields. It is also clear that the high rates of student turnout in agricultural education. Figure 6 illustrates the total number of students registered in both the general and technical secondary schools.

The hotel technical secondary schools' development began in 2011/2012 with 38 schools and 13,444 students. In 2017, the school numbers became 79 schools, and student's numbers were 24,165 students. The rise in the number of schools, reflecting the State's interest in hotel education.

**Table 5: The development of the industrial technical secondary school from 2002-2019**

Year	2002/2003	2006/2007	2010/2011	2014/2015	2016/2017
<b>Industrial Technical Secondary Schools</b>					
School's number	805	863	866	956	1111
Class's number	27,255	25,673	24,437	23,934	24,892
Student's number	991,554	907,598	836,668	805,673	874,326
<b>Commerce Technical Secondary Schools</b>					
School's number	723	530	558	569	587
Class's number	21,221	14,645	13,757	14,285	14,426
Student's number	849,856	584,233	491,260	547,949	573,915
<b>Agricultural Technical Secondary Schools</b>					
School's number	171	174	180	205	241
Class's number	6,279	5,006	4,725	4,597	5,050
Student's number	252,426	185,499	161,665	168,705	210,369

\*[Source: Capmas's annual reports]

### 3.1.2.5 Access to female students in public education

Table 6 presents the percentage of female students enrolled in various urban and rural public schools. It is worth mentioning that the ratio of female students is equivalent in the urban and rural areas. This ratio is higher than the male students in the community schools and slightly increased in the public general secondary school. The female percentage is much less in the industrial, agricultural, and hotel technical secondary and special schools. On average, females enrolled in a commerce technical school is 60% compared to male students.

Concerning the availability, we noted an increase in schools' number at all education levels during 1990-2016. Through the plans of the pre-university education strategy, prompted by the Ministry of Education, pays attention to the fairness and quality of educational buildings to achieve total absorption of pupils and reduce the dropout rate. The Government's policy of "eliminating the negative impact of the government's policy on the state of the environment" is to ensure that the Government's efforts to address the crisis are not only a matter of priority but also a significant challenge to the Government's efforts to address the problems of the poor. Two extended 982 schools and 842 schools are operating in a second shift. In contrast, 842 schools are

working in the third shift. Only 36.3% of preparatory schools use a full-day system. Also, the multi-use classrooms, playgrounds, and lounges have disappeared from many schools to expand classrooms. It has compounded the negative impact of the diversity of shifts on extracurricular activities. It has often eliminated, detracted from the school's educational function, and has also destroyed many pupils' appeal.

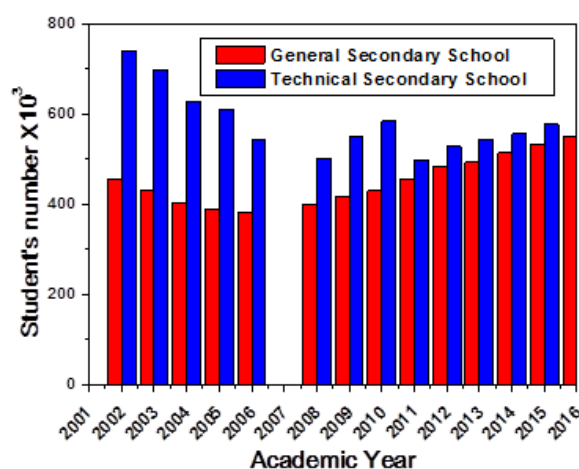


Figure 6: The development of the student's number registered in secondary schools from 2002-2016

The number of pupils per class is an essential indicator of the quality of the educational process. Table 7 shows the class density for each education level during 1990 – 2019 (CAPMAS, 1990-2020). These figures reveal that private schools at all levels have fewer pupils each semester than those in public schools. The high density of statistical indicators of the seasons is evident.

According to many interesting international reports on Egyptian education, Egypt has gone a long way in making access to the educational service in general. Concerning the quality of the academic assistance, these reports indicated that the real challenge facing Egypt's pre-university education system was its ability to improve the quality of the service. Quality meets several main things: reducing classroom density, facing low levels of performance for students at all levels of education, reducing the repetition, dropout, and absenteeism, confronting the phenomenon of fraud, addressing poor literacy and numeracy among some students, attention to school activities and the use of technology to suit each stage, applying active learning and comprehensive evaluation, emphasizing child-centred learning, and qualifying schools, teachers and mentors to apply functional knowledge as a strategy to improve the quality of the educational process

Table 6: The percentage of female students enrolled in various education stages from 2014-2019\*

School	2014/2015		2015/2016		2016/2017		2017/2018		2018/2019	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Kindergarten	48.30	47.77	48.19	47.74	48.41	47.81	48.42	48.19	48.56	48.28
Primary	48.51	48.37	48.53	48.37	48.53	48.42	48.54	48.45	48.60	48.59
Community	64.09	79.31	62.58	76.59	61.19	74.50	58.15	72.83	56.80	71.38
Preparatory	48.51	49.89	48.39	49.75	48.17	49.61	48.08	49.51	48.06	49.23
General Secondary	53.52	53.64	53.34	54.30	53.46	54.64	53.65	55.19	54.05	55.74
Industry Secondary	34.83	40.42	34.41	41.04	34.75	41.00	35.16	40.55	35.54	41.21
Farm Secondary	19.49	15.41	18.81	14.51	17.29	12.82	17.13	12.71	15.68	13.80
Commerce Secondary	64.69	54.19	64.11	55.13	64.09	54.69	63.52	53.73	62.88	52.97
Hotel Secondary	31.91	30.86	32.48	29.94	33.08	29.13	32.95	27.47	33.37	26.36
Special	37.50	34.26	37.53	33.98	37.38	33.34	37.62	33.01	37.38	32.79

\*[Source: Capmas's annual reports]

### 3.1.2.6 The statistics on the class density during the period 2000-2019

Table 8 illustrates the development of class density during the period 2000-2019. The State's efforts in the element of availability are apparent. It focused on quantitative expansion at the qualitative expense, as evidenced by the classes' high density, especially in the provinces. According to data from the General

Authority for Educational Buildings, buildings with high densities starting with 41 students/classes account for 35.9% of all educational establishments. The average class density is more than 70 students/classes is at all levels of education. It means that the overall average hides significant variations if the analysis is finishing at lower administrative groups such as the directorate.

**Table 7: The development of the class's density in the kindergarten, primary, preparatory and general secondary schools\*.**

Year	Kindergarten	Primary	Preparatory	Secondary	Year	Kindergarten	Primary	Preparatory	Secondary
1989/1990	---	43	43	37	2004/2005	31	41	44	41
1990/1991	---	44	43	37	2005/2006	31	41	43	41
1991/1992	---	44	42	36	2006/2007	31	41.5	43.1	43
1992/1993	---	45	42	39	2007/2008	31	41.6	42.6	42.1
1993/1994	---	44	41	39	2008/2009	30.6	43.3	39.8	41.6
1994/1995	---	44	41	38	2009/2010	30.8	43.8	39	39.8
1995/1996	---	44	42	38	2010/2011	31.6	44	39	38.2
1996/1997	---	44	42	38	2011/2012	32.8	44.4	41.5	33.5
1997/1998	---	43	43	38	2012/2013	33.7	44.7	42.3	33.7
1998/1999	---	42	43	39	2013/2014	30.8	39.2	37.1	31.8
1999/2000	---	42	44	41	2014/2015	34.4	43.8	41.2	38
2000/2001	31	41	44	41	2015/2016	35.6	44.5	41.1	39.1
2001/2002	31	41	43	41	2016/2017	36	44.7	41.8	39.2
2002/2003	31	41.5	43.1	43	2017/2018	36.5	44.3	41.4	39.2
2003/2004	31	41.6	42.6	42.1	2018/2019	37.9	45.8	43.1	41

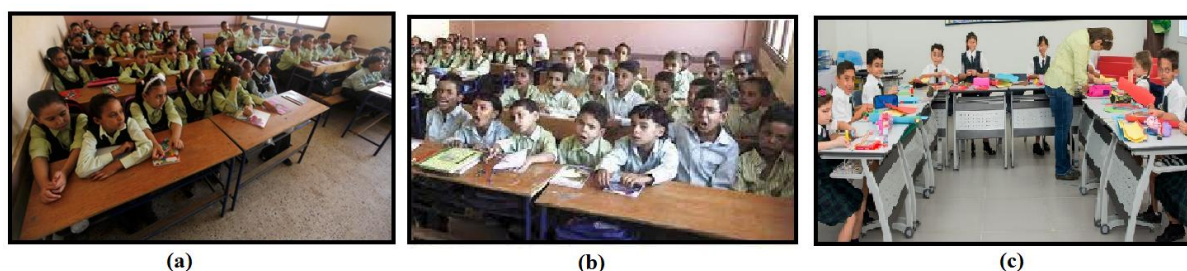
\*[Source: Source: Campa's annual report]

Figure 7 (a,b,c) illustrates the high-class density in Cairo's public and private primary schools. Also, the buildings' poor quality is evident from the schools' operation over two extended shifts. The multiple school shifts and educational buildings' inability to absorb students' numbers lead to the disappearance of activities and playground halls. It negatively affected the quality of the educational process. Schools operating for more than one shift are concentrated in greater Cairo's popular and poor neighbourhoods, reflecting the educational process's unfairness. The status of existing buildings, the document "Mubarak National Project" indicated about 25,000 schools in Egypt. More than half of the schools were not fit by all accounts. Thousands of schools did not have toilets, thousands fell, and thousands without windows or doors (NCSCR, 2002).

**Table 8: The development of the class's density in the kindergarten, primary, preparatory, and general secondary of the public and private schools\*.**

School/Year	2000/2001		2005/2006		2010/2011		2015/2016		2017/2018		2018/2019	
	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
Kindergarten	31	30	30.8	27.7	34.4	29.9	38.3	30.2	37.99	30.24	38.68	30.26
Primary	41	35	43.8	33.5	43.8	31.94	47.1	33.7	49.73	33.54	51.43	34.53
Preparatory	44	30	38.9	29.7	41.2	29.28	43.6	30.2	45.24	30.72	46.89	30.87
Secondary	41	32	39.8	27.9	38	27.55	41.2	31.1	42.56	31.39	42.59	31.39

\* (Source: Source: Campa's annual report)



**Figure 7: Class density in a and b) primary public school, c) International private primary school in Cairo.[source: arabnews.com]**

The biggest obstacle to the failure to resolve these problems was the lack of investments. In particular, these insufficient schools have, in some cases, encouraged families not to send their children and keep them at home. It may even be a reason for the low level of education and the use of private lessons. The General Authority of Education Building documents the inferior status of the public school buildings. It determines the increase in population and poor distribution in some places. The principle of compulsory primary education adopted for eight years with a commitment to free education and allocating funds is disproportionate. The

earthquake of October 12, 1992, resulted in some school buildings' cracking and demolition. The needs for educational establishments for the period from 1991-1997 have estimated as follows(NCSCR, 2002, and MoE, 2010):

- The current number of schools is 25,000.
- To eliminate the multiplicity of shifts is 5172 schools.
- To reduce classroom density in 820 schools
- To replace 2,580 schools.

Concerning the quality of school construction, the literature on effective schools has highlighted in developed and developing countries the importance of the physical environment through which students learn. Both pupils and teachers must have a safe and healthy school environment and have space and spaces designed to support the preferred educational method. Table 9 presents the data concerning the schools' standards and planning requirements, including the classroom's density, the number of classrooms for the school, and the pupil's number enrolled. These data had identified by the General Authority for Urban Planning (GAUP, 2014). Increasing classroom density is one of the main problems and urgent needs of school buildings. With an average classroom density of 10,620, it accounted for 41.6% of the total of the 25,554 existing and functioning government school buildings. Table 10 shows the class density distribution and its comparison with the standard rate of 36 to 40 students/class in various education stages. It indicates that the public schools in Egypt are overcrowding

**Table 9: The school planning standards and requirements \***

Educational service		Primary	Preparatory	Basic Education	Preparatory/ Secondary	Basic/ Secondary
Class Density	The minimum limit	25	25	25	25	25
	The upper limit	40	40	40	36	36
	Preferred desired limit	30	30	30	30	14
Class's number /school	The minimum limit	8	9	11	12	14
	The upper limit	40	30	55	60	70
	Preferred desired limit	24	24	33	36	42
Student's number/ school	The minimum limit	320	360	440	432	504
	The upper limit	1,600	1,200	2,200	2,160	2,520
	Preferred desired limit	720	720	990	1,080	1,260

\*[Source: General Authority for Urban Planning, 2014, 32]

**Table 10: The Distribution of class.s density and comparison with a standard\***

Class's density Statement	Percentage of buildings among government buildings
Buildings with a higher density than standard up to 50 students per class	5,140 buildings by 20.1%
Buildings with a density of 51 to 60 students in the class	3,037 buildings by 11.9%
Buildings with a density of 61 to 70 students in the class	1,304 buildings with 5.1%
Buildings with a density of more than 70 students in the class	1,139 buildings up 4.5%

\*[Source: CAPMAS, 2020]

#### IV. EDUCATIONAL BUILDING REQUIREMENTS OF TECHNOLOGICAL EDUCATION DEVELOPMENT

The strategic plan for pre-university education reform 2007-2012 identified priority programs for education reform. These programs aimed to support Egyptian children's capabilities for the tools of the era of science and technology. They can interact with the third millennium's challenges and provide them with the abilities and expertise that will help them compete [46].

The developing programs and their expected outcomes include technological development and information systems to introduce the ICT infrastructure and provide the necessary technical support for implementing and continuing modern teaching/learning methods and effective educational management. The program's sub-procedural objectives for academic buildings were to modernize and update all schools' technology infrastructure.

The Government's decision to amend the Law on the child's rights is a matter of concern. The 2007-2012 strategic plan for pre-University education indicated that computer infrastructure, equipment, and laboratories have been developed and put into operation in many schools. Many schools had equipped with 1,800 multimedia laboratories at the kindergarten level, 11,925 primary schools, 6,195 preparatory schools, and 1,205 secondary schools. These schools had many issues and challenges as follows:

- The current situation indicates that many computers are not used effectively in schools.

- Despite the Ministry's efforts to provide schools with equipment, the distribution of equipment and laboratories is uneven, as childhood and primary school suffer from a severe shortage of computers, to the extent that the average number of devices in kindergarten sits at one computer per school, and three devices per primary school.

The industry aimed to use advanced information technology in schools. A further 15,995 intel trainees have trained, 16,196 trained in Microsoft, and 7,600 trained in computers which have provided to schools.

The national technology project also aims to provide schools with high-speed technology, a plan developed by the Ministries of Communications, Information, and Education. Seven thousand seven hundred preparatory schools progressively connected through high-speed technology. The preparatory schools provided with 12 computers and accessories. The first phase targeted 2,000 schools.

The strategic plan for pre-university education 2007-2012 included the technological development and information systems program. These programs aimed to complete the infrastructure and technical support for applying ICT and use it optimally to develop the educational process and remote training and asset management systems in all fields and at all levels. The program's achievement based on the provision of the necessary technological infrastructure during the 2007-2012 five-year plan through (MoE, 2014):

- Providing schools with a minimum of technological infrastructure needs.
- Providing classrooms with technological ICT infrastructure,
- Providing 50% of primary schools with ICT infrastructure,
- Completion of preparatory schools with ICT infrastructure,
- Providing general secondary schools with ICT infrastructure.

Despite the interest in providing schools with ICT for more than two decades and investing many financial resources in this direction (as indicated by the Strategic Education Plan 2014-2030), there is still a lack of technology infrastructure in schools. For example, about 14,000 non-tech primary schools account for about 85% of public schools. The Economic and Social Development Plan of 2012/2013 mentioned that only 27.4% of preparatory schools equipped with computer labs out of 9,005 schools occupying 7,900 school buildings, and there are 2,163 computer labs. Keeping in mind that the mere provision of laboratories does not meet the quality of education unless ICT is optimized and supports the classroom's teaching and learning process.

## **V. DISCUSSION**

We studied the development of school construction and maintenance at all levels of education from 1990 to 2020. We have the following:

1. The educational building is essential in implementing scholarly and educational plans in all its dimensions.
2. The building is designed following educational specifications and includes the facilities, equipment, and tools necessary to implement educational programs and their success.
3. To keep academic buildings' technical condition, we need to implement an integrated strategy for maintaining educational facilities and their installations, machines, equipment, and precise equipment.
4. Despite the increase in annual school numbers, there has been a rise in classroom density. Full availability did not achieve. One of the reasons for this may be the State of dilapidated educational buildings and the high proportion of invalid buildings, which may reach 23% of the total buildings.
5. We need to find scientific solutions to implement a plan for the total absorption of students at all age levels in the educational ladder following population growth and improved academic service, reducing classroom density and replacing dilapidated educational buildings.
6. It is essential to identify the current situation through two pillars: availability and quality, where the steady population increase has placed increasing burdens on the demand for education, leading to a trend of quantitative expansion at the expense of spending on quality standards in some cases, reflected in the high density of classes, the diversity of school shifts and inadequate school equipment.
7. Despite efforts to construct new educational buildings so that all children can be made available and pupils can accommodate, the rehabilitation and restoration of other school buildings burden the State.
8. The manifestation of the shortage of school buildings is the assortment of shifts. A small number of schools operate on a full-day basis, which negatively affects effective learning.
9. It detracts from the school's educational function and undermines its attractiveness to many pupils.
10. The statistical indicators demonstrated the lack of quality of educational buildings to track the classroom density evolution in the educational stages.
11. The density of the classroom showed to be higher than the average. This negative impact affected a) learning effectiveness, b) encouraging a segment of families not to send their children to school and go to private lessons, c) it led to one of the reasons for dropping out of education.
12. There is a lack of technology infrastructure in schools, as demonstrated by educational buildings' position in technological development requirements.

13. Many factors affect the availability and quality of educational buildings, one of which is the budget for spending on aspects of the educational process, mainly allocated to the development and maintenance of academic facilities.
14. The infrastructure for ICT technology needs a lot of financial resources.
15. The pre-university education spending rate is increasing.
16. There is no justice in the distribution of financial allocations to the governorates of the country.
17. There is a discrepancy in public government spending compared to the increase in wages in recent periods.
18. There has been an inflation of the administrative apparatus and non-teacher workers, resulting in a large proportion of the wage allocation.

From the discussion mentioned above, it is possible to deduce several factors affecting the availability and quality of educational facilities. Below we give some influential factors as follows.

#### **A. Steady population growth:**

The population increase has placed an increasing burden on the demand for education, leading to a trend of quantitative expansion of educational buildings at the expense of spending on quality standards, reflected in high classroom density, multiple school shifts, and inadequate school supplies. The increase in the population requires more services and, consequently, more spending. We suppose to know in advance the influence of population growth on the educational process's development. Even studies have been able to determine the population numbers and the expected increase in the future. The increase itself is assumed to be known for decades because of the rates. Therefore, the lack of state planning for these rates created the problem. As a result, children did not fully accommodate, classes are overcrowded with pupils, and the classroom density has negatively affected the educational process.

#### **B. Spending and funding:**

It did not calculate what this would entail from the numbers doubling when free education had decided. It requires providing multiple elements necessary for the education process. The educational service level is declining year after year, which led many to ask for educational institutions' alternative paths. These, namely private lessons, burdened Egyptian families with the learning of their children. Free education has become virtually unreal, and the difference is that those who now take the cost of education are the owners of alternative learning pathways, not the State.

#### **C. Social justice and equal opportunities:**

There is no doubt that equal educational opportunities are educational policy components. Education is one of the fundamental human rights stipulated in international conventions, and the Universal Declaration of Human Rights says that every human being has the right to education. It should be accessible at least in its early stages. Primary education should be compulsory. It means providing equal opportunities for equality and justice among members of society in enrolment and admission to educational institutions, and equal treatment within these institutions, without class discrimination or exception for some individuals at the expense of others. This principle is undoubtedly linked to free education, which requires the equitable distribution of education spending in all sectors of society. Justice and equal opportunity also expand the numbers of schools and classes and meet educational needs such as buildings and equipment. Education indicators indicate a gender gap and significant geographical gaps in illiteracy and access to education in Egypt.

- Justice in public and private education: By addressing the extent to which justice is taken care of in public and private education, there is a disparity between public and private schools, for example, concerning classes' density.
- The Government's policy of "protecting the rights of the population" is a matter of concern. The total spending on pre-university education is 37.7% of total expenditure in the Delta region. While in upper Egypt, it is 25.6%. This difference was indicating a lack of justice in distributing financial allocations to governorates. The geographical gap index had also identified in the opportunity to complete the index
- The disparity between the governorates of the maritime face, from tribal, urban, and rural areas, was also found by comparing educational buildings' status according to geographical distribution.
- Unfit school buildings account for 23.8% in Egypt. There are a high percentage of invalid facilities in upper Egypt and some border governorates. It is evident in Aswan 44.7%, while for the border provinces, the highest rate in Matrouh governorate, where it is 63.6%. The overall average is 16% for the urban governorates, and the lowest of 15.3% in the Cairo governorate,
- The disparity between rural and urban areas is also evident in students' poor distribution in the classrooms between the provinces. The density is more than 55 students/classes in some regions, compared to 15 students/class in others.

- Justice in education between males and females: Concerning the extent to which justice is taken care of in education between males and females, education indicators indicate a gap in literacy and enrolment rates in Egypt, where the illiteracy rate in 2014 was 23.2% in the overall level, while among males it was about 15.7% compared to 31% among females.
- Justice in education among different regions: the residential areas in Egypt vary in terms of their expression on the economic level and affect their enjoyment of educational services. Justice in the distribution of educational opportunities and services among different regions did not achieve. For example, communities such as Misr AlGidida (located east Cairo) or Zamalek have more educational benefits than those provided in popular areas (especially those slums) such as Zeinham and Bulaq regions.

#### **D. Lack of land and poor planning:**

Based on the State's interest in educational structures and the establishment of a general environment for educational facilities, to be responsible for the establishment of academic buildings, and then to work to increase the number of schools to solve the problem of absorption, increase the density of the class, and the diversity of shifts in the same school. We suggest that one of the reasons is that there is not enough land to be built on, especially in slums, which are sometimes informal. In addition to neglecting these regions of state interest, this seems to lack justice in school buildings' distribution. The General Authority for Education Building considered that the lack of suitable land for constructing school buildings and their scarcity was one of the main problems impeding education availability, especially in the most needed areas. Besides, there is no school map of facilities at the national level or residential neighborhoods. The plans to expand schools' construction have not kept pace with the steady increase in the population.

#### **E. Absorption and leakage:**

Despite the efforts of educational policies in learning and assimilation, it is clear that keeping pupils until the completion of the stages of education still needs to be improved. The dropout rate at any stage reflects the proportion of pupils who drop out of school during a school year to the number of pupils enrolled in the same year. The primary dropout rate in 2005/06 was about (0.22%), while the total number of dropouts in primary education between 2010/11 and 2011 was 28,841 pupils, with 130,564 dropouts from the preparatory education cycle. The dropout rate in the preparatory school cycle was 6%, and there are 14 provinces with a higher dropout rate than the average (Matrouh, North and South Sinai, Beni Suef, Asyut, Sohag, Red Sea, Minoufia, Fayoum, Qena, Damietta, Western, Luxor, Qalyubia). The reduction in dropout rates in the primary and preparatory levels for 2006, 2007, 2008 and 2010, 2011, and 2012 maybe because this stage is mandatory. In primary school, the dropout rates decreased from 0.7% to 0.34%, and in the preparatory phase, they dropped from 6.5% to 6%. The problem of school dropouts is due to many reasons, including poor economic and social conditions. Besides, it is related to the educational environment that is not attractive to students in schools that help drop out. It includes high-class density and overcrowding, which leads to the student's hatred of study and educational failure. Failure is due to several reasons, including the lack of an effective learning environment, overcrowding of the classroom, and the lack of learning environment and equipment that may affect students' absorption. The lack of the necessary technology and communication sought to help students communicate information more simply and clearly may reduce scientific returns and harm achievement.

#### **F. The density and accumulation of classes:**

Statistical indicators showed an increase in the classroom's density above the average. They were considered one of the main problems and urgent needs of school buildings. The proportion of school buildings with average classroom density was 41.6% of the total existing public school buildings. However, classes' density was higher in public schools than in private education (see Table 9). It is worth mentioning that the class density increases in slum schools in the same province, maybe due to many people's displacement to these low cost of living areas. More than one family can reside in one apartment, which leads to an increase in the number of children of school age. These circumstances are not commensurate with the number of schools in these neighborhoods, resulting in increased class density and multiple shifts in the same school.

The schools' operation in different shifts is one of the General Authority for Education Building's main problems. The number of buildings operating in the multi-shift system was 4,684, representing 18.33% of the total of the 25,554 existing and operational government buildings

## **VI. CONCLUSION**

In this report, we studied the development of the school building in Egypt from 1990 to 2019. We conclude the following:

1. The school building is essential in the implementation and success of educational plans in all its dimensions.
2. The school buildings, in most cases, have not been designed according to educational specifications.

3. The school buildings lack the necessary facilities, equipment, and tools to implement and succeed in educational plans.
4. In the context of making education available to students in the age group, the steady increase in the population increasing burden on the demand for education,
5. The trend of quantitative expansion at the expense of spending on quality standards had reflected in high classroom density, multiple school shifts, and inadequate school supplies,
6. Despite the increase in the school's number per year, there has been a rise in the class's density. Full availability has not resulted from school operation in different shifts, which negatively affects effective learning.
7. The class's density in the various educational stages increased from the average, encouraging many families not to send their children to school and go to private lessons. It is one of the critical reasons for dropping out of education.
8. Another manifestation of the lack of quality of school buildings is that there is still a lack of technology infrastructure in schools.
9. Many factors affect the availability and quality of educational buildings, such as:
  - Although there is an increase in spending each year from the Ministry of Education budget, it turns out that the allocations are weak and the exclusion of wages increasing lying about this expenditure; in contrast, the spending on educational construction projects and maintenance is meagre.
  - The steady increase in the population
  - The hamble of social justice and equal opportunities,
  - The lack of land and poor planning.
  - Some of the results were found, including the classrooms' density overcrowding; the lack of availability leads to leakage and failure.

### **ACKNOWLEDGEMENT**

This research is part of the project entitled "Cairo University proposal to develop education in developing countries in the Egyptian context." The financial support of Cairo University is acknowledged.

### **Declaration of Conflicting Interests and Ethics**

We declare no conflict of interest. This research study complies with research and publishing ethics.

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