Ain Shams University
Egypt

Rethinking School Design to meet 21st Century Learning Demands

The Case of Egyptian Governmental Schools

A Thesis submitted in the Partial Fulfillment for the Requirement of the Degree of Master of Science in Integrated Urbanism and Sustainable Design

by

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July 2021

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Abstract

Rethinking School Design to meet 21st Century Learning Demands:
The Case of Egyptian Governmental Schools

Sandra Nabih Samir Labib

Education has always played a crucial role in the development of nations. It is considered the fundamental investment in human capital. Through schools, children are taught the skills they need to succeed in this new world, and in order to prepare students for their unpredictable future, schools must be designed in a way that suffices the demands of the 21st century. In Egypt, education still follows 20th century learning, and schools are still designed according to the standards of industrialization. While rapid shifts are taking place globally towards 21st century learning, and school architecture is being redefined, governmental schools in Egypt are still lacking, falling short in addressing the 21st century learning demands.

The aim of this research is to understand the history of how traditional school buildings came to be and what they served, comparing them the needs of the 21st century. It will further shed light on 21st century learning and how it is reflected in school design. The research will then focus on the local case of Egyptian governmental schools, analyzing and evaluating how they serve the learning demands of the current era. Finally, design guidelines will be recommended to ensure that Egyptian school design shifts to meet the demands of 21st century learning.

By reviewing literature and conducting field visits to a random sample of governmental primary schools, this research will highlight how schools and education were always a reflection of society's dynamics, aiming at reaching society's present and future demands and promoting them spatially. Through questionnaires and co-design workshops with the children, the paper will also shed light on the school users' opinions, so as to be able to reach holistic design recommendations that fulfill modern learning demands.

Keywords: Factory Model education, 20th century learning, 21st century learning, 21st century skills, School design, Egypt.

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List of Acronyms and Abbreviations

ODEP	Open Door Economic Policy / “Infitah”
STEM	Science, Technology, Engineering, Mathematics
P21	Partnership for 21st Century Learning
3 R's	Reading, Writing and Arithmetic
4Cs	Learning Skills of the Framework for 21st Century Learning
CBSE	Central Board for Secondary Education, Delhi, India
OECD	The Organization for Economic Co-operation and Development
ENC	East Nasr City, Cairo, Egypt
M	Maadi, Cairo, Egypt
BD	El Basateen and Dar El Salam, Cairo, Egypt
W	El Waily, Cairo, Egypt
MN	Manshiet Nasser, Cairo, Egypt
GAEB	The General Authority for Educational Buildings
IPS	International Public School
MEP	Mechanical, Electrical and Plumbing systems of a building

I. Introduction

Shifting Paradigms

Background

For the past century or more, traditionally designed school buildings have defined school architecture all over the world. Featuring long corridors that were designed for controlled movement, and "egg crate" classrooms (Fisher, 2010) in which 20 or 30 children sit individually, expected to learn at the same pace in the same way, these buildings have continued deep into the 21st century. Since the traditional school building originated in the Industrial Era, it was designed to serve the economic and political needs of industrialization, promoting standardization. Children entered schools to be introduced to the industrial society, where they would all perform the same tasks under strict rules, learning by memorization and indoctrination.

This ideology continued further into the 20th century, where after the mass destruction of WWII, mass education was crucial. Standardization and new construction materials took the lead in erecting new buildings rapidly and with minimal cost. In Egypt, the case was similar. In the mid-1900s, standardized school buildings made their way into the country for the purpose of mass education, and until this day, this standard design and education system is used. Yet is this the education needed today?

Nowadays, countries all over the world are taking strong action towards reforming education. Learning is being redefined as an active, not a passive process, in which the student's active involvement is equivalent to the teacher's contribution, if not more. In other words, learning is shifting from a teacher-delivered knowledge to a combination of both teacher-delivered and student-processed knowledge. It is becoming more oriented towards group learning and bridging the gaps between previously disintegrated areas of knowledge. The visions of traditional schools and education are being re-evaluated, and the purpose on which they were based is being questioned.

The 21st century has shifted from an industrial-based economy to a knowledge-based economy (SEG, n.d.), and with the rise of technology, it was found that students graduating from schools are not equipped with the skills they need to thrive in today's world. That is why, new educational reforms are being made, identifying skill development as the key to 21st century learning. This is being reflected on school design through many spatial manifestations. Therefore, school building design is evolving to meet the demands of the 21st century learning.

1.1. Research Problem

While education and school building design are developing all around the world, 20th century education has continued deep into the 21st century in Egypt. Children are still being taught a standardized curriculum through rate learning and individual testing, at a one-size-fits-all pace. Rote memorization and standardization are being applied. "Perhaps the biggest structural problem, however, is the outdated curricula. The schools consequently churn out "graduates with no future," who lack the necessary skills for employment in a modern economy." (Mohamed, et al., 2019)

Though the world is shifting towards integrated learning and developing 21st century skills, Egyptian education has not changed. In turn, school buildings still resemble those of the mid-20th century. A standard school prototype is found all over the country, composed of the same long corridor overlooked by rigid-set classrooms. The components of the building rarely inspire or work on developing skills, since their aim is to discipline and control. While school design is shifting towards 21st century design to promote 21st century learning and skills, Egyptian governmental school buildings are still designed according to the 20th century principles. This in turn means that they do not serve 21st century learning.

This research accordingly studies the case of Egyptian governmental schools, examining their history, the principles on which they were originally based and their physical design. It also explores the relationship between the physical design of the building and how the learning process occurs, specifically focusing on how the building can be altered to fulfil 21st century learning demands.

1.2. Research Objective

The research aims at providing design guidelines to turn Egyptian school buildings into 21st century schools, promoting 21st century skills.

1.3. Research Questions

The research questions are sub-divided into two sections, main and secondary questions. The main question is: **How can Egyptian schools be designed/redesigned to serve 21st century learning demands?**

The secondary questions are:

- On what basis were traditional school buildings designed?
- What is the difference between 20th and 21st century learning?
- What are the 21st century skills and what is their importance?
- What are the design features of 21st century schools?
- What school prototypes do we have in Egypt? What spatial design and qualities do they feature?
- How do children experience their schools? What are students' and teachers' needs in school buildings?

1.4. Research Methodology

Since this scope of study interlinks several different fields, it is important that they are all investigated. Therefore, the literature review will be divided into three parts. The research will begin by reviewing literature on the history of school architecture, and 20th century school architecture. It will then shift to focus on the evolution of schools in the Egyptian context, and what they have come to include today. A brief study of the Egyptian educational system will also be covered. The second part will inspect the differences between 20th and 21st century learning demands, further focusing on the 21st century skills and their importance, and finally which skills should be developed at what age. The third and final part will focus on the spatial aspects, studying the difference between 20th and 21st century school buildings, the design principles of 21st century schools, and the different methods of applying these principles spatially through case studies.

The empirical study will be divided into four parts:

- Data collection from the designers of educational buildings in Egypt (The GAEB)
- Field observations by visiting a random selection of Egyptian governmental schools to observe and analyse their spatial design and components.
- User questionnaires: Online questionnaires directed to governmental school students, their parents, and the teachers to collect information on their experience inside the building and their needs.

- Children's Co-design Workshops: Workshops conducted with children to collect further data and insights on their school experience, and to engage them in the design process of new classrooms that meet 21st century learning demands.

Finally, the research will present a discussion of all findings and the recommended design guidelines to make governmental Egyptian schools meet the needs of 21st century learning.

1.5. Limitations

Owing to the case of the global pandemic (COVID-19), and the fact that education is considered a matter of national security in Egypt, some limitations might present themselves in conducting the field visits to inspect the buildings. The availability of data and ability to photograph or document the buildings might not be possible. Reaching students and educators might also pose a challenge since schools are not normally operating under the conditions of the pandemic, therefore the samples will be reached through online platforms and social media, using online questionnaires. In addition to that, although the study involves many stakeholders, yet the focus of this study will only be on those directly related to the school building: the designers, the users (students and teachers) and the parents. Finally, due to time and resource limitations, the random sample of schools selected will only be within the district of Cairo, Egypt.

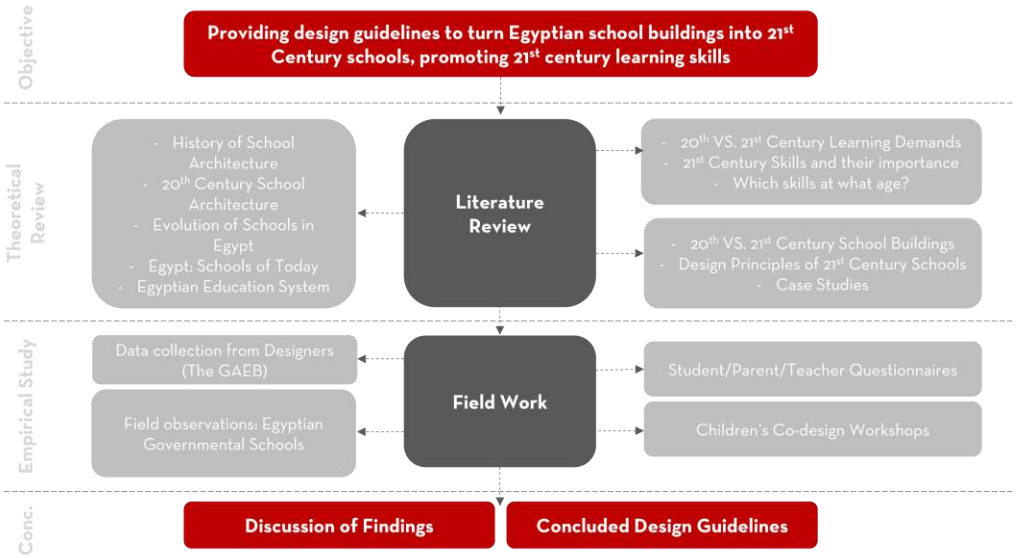


Figure 1: Research Methodology

II. Literature Review

The Evolution of School Architecture on the Global and Local Scales

School architecture of the 20th century, also known as "traditional" school architecture, originated in the 18th century, the era of the Industrial Revolution. Given the name "factory model schools" by Howard Lamb in 1972 (Robinson, 1972), these buildings strongly resemble factories for learning, where teachers transfer their knowledge onto students, then students are tested to see whether they have retained the knowledge that has been presented to them. Yet to understand the origins and reasons why 20th century school buildings took their current form, it is essential to review the history of school architecture and education, and the social, political, and economic dynamics that led to its current form.

2.1. History of School Architecture

2.1.1. The Industrial Revolution (1760 – 1840)

The First Industrial Revolution began in Britain in 1760 and lasted until around 1840. During this period, all human and animal labour shifted to mechanization. Many productions such as cotton, wool, coal, and iron grew enormously, and with the invention of the steam engine, the early modern industrial era began globally. The steam engine brought revolutions in textiles, mines, steam-powered railroads and freighters, steel production, and other areas of economic activities. This made massive expansion of cities, industries, and infrastructure of all kinds. (Mohajan, 2019) As a result, living standards rose generally due to economic developments.

With the spread of the "factory system", mass population was provided with new job opportunities that resulted in mass rural to urban migration. Because of the development of medical science, the improvement of sanitary systems and economic development,

child and infant mortality rates decreased, and fertility rates increased. Consequently, unprecedented population growth took place in England, Europe, and the world.

2.1.2.Factory Model Education

In 1776, pioneering Scottish philosopher and economist, Adam Smith set stage for the Human Capital Theory. He identified the acquired and useful abilities of individuals as a fundamental source of wealth and economic progress of a country (Spalletti, 2014). These capabilities could be increased through investment in things such as education, on-the-job training, and health. (Eide & Showalter, 2010) Smith saw the Industrial Revolution as the ideal outset for nations to educate their populations to gain wealth and mass production, claiming that "The more they are instructed, the less liable they are to the delusions of enthusiasm, and superstition" (Carl, 2009).

Yet this new industrial era required a new kind of man to serve its purposes. It demanded skills that neither family nor church could provide. Above all, it required that man develops a new sense of time (Toffler, 1984). As production shifted and accelerated from the farm to the factory, higher levels of interdependency required collective efforts, highly specialized division of labour, coordination, and integration of many different skills (Walden, 2015). Therefore, between the great rise in population growth, the mass rural to urban migration, the theory of human capital and economics of education, and the new persona required to achieve nations' wealth, a need for education swelled. "Mass education was the ingenious machine constructed by industrialism to produce the kind of adults it needed." The new era needed an education system that would pre-adapt children for this new world (Toffler, 1984). This new education system would simulate the new world that they would emerge into. As Toffler put it, "The whole idea of assembling masses of students (raw material) to be processed by teachers (workers) in a centrally located school (factory) was a stroke of industrial genius." (Toffler, 1984)

Figure 2: The Factory System (Wong, 2020)

Figure 3: Factory Model Education (Chase, 2015)

The whole administration of the new education system followed the model of industrial bureaucracy. From the very organization of knowledge into permanent disciplines, to children marching from place to place in lines and sitting in assigned stations, to the ringing of the bells announcing changes of time. The whole system was grounded on industrial assumptions, and the inner life of the school became the perfect introduction to the industrial society. "The most criticized features of education today—the regimentation, lack of individualization, the rigid systems of seating, grouping, grading and marking, the authoritarian role of the teacher—are precisely those that made mass public education so effective an instrument of adaptation for its place and time" (Toffler, 1984).

Children passing through this "educational machine" emerged into an adult society that almost identically resembled the structure of the school itself. The belief was "the back door of the school lead to the front door of the factory" (Creativecurriculumisabella, n.d.).

2.1.3. The Prussian System

Prussia was one of the first countries in the world to try to introduce a generally compulsory primary education. In 1763, Frederick II promulgated a general school regulation stating that primary schools would be under full control of the state, and that all families must send their children from 5 to 13 years of age to school or else they will be fined. (Li, 2020) This decree made Germany the first country to take power over education from the Church. Yet Prussia's compulsory education at that time was considered a political education with militaristic meaning. Children were provided not only with the skills needed in an early industrialized world (technical skills, reading, writing and arithmetic) (Ellis, et al., 2014), but also to be indoctrinated with blind obedience, diligence, ethics, duty, and discipline.

The Prussian education system consisted of tiers. It comprised of an eight-year course of primary education "*Volksschule*", "*Realschule*" which was secondary school, and Gymnasium which was advanced secondary education, also considered university-preparatory school. The children were grouped by age according to date of birth, and were taught the same content by one teacher, only to be moved onto the next year to the next classroom with a new teacher and differing content (Figure 4). Between 1788 and 1812, Prussia had established an examination system, The Abitur, which acted as a high school graduation certificate and a form of precondition for admission to university. The state also introduced state certification requirements for teachers, and Teachers' Seminaries "*Volksschullehrerseminare*" were established, to increase the quality of teaching (Glavin, 2017).

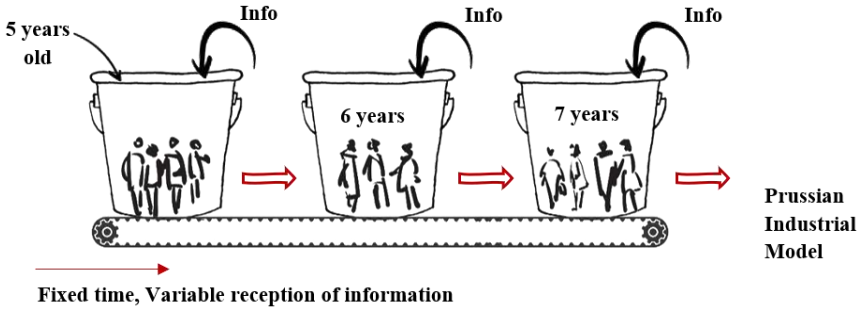


Figure 4: The Prussian System (Khan & Noer, 2012)

The success of the system made other countries send their educators to be trained in Prussia, and those in political power became fascinated by the system's ingenuity, including the United States.

2.1.4. School Buildings in the Industrial Era

2.1.4.1. Monitorial Schools

To suffice the new demands of mass education, new measures had to be taken in terms of education and construction. In 1798, Joseph Lancaster proposed a new concept for public education in England. It was based on mass public education using older and more advanced students as teachers, known as "monitors". The Lancasterian educational system and schools were governed by strict rules and discipline. A headmaster who selected and trained the student monitors had full authority over them. They, in turn, taught students who were younger and less educated.

The system's main flaw was the rote memorization of lessons which crumbled when the smallest degree of thought was required of the student yet was the ideal method for educating masses and for "crowd control". Within a decade, Lancaster's plan had spread throughout Europe and reached the United States (Rayman, 1981).

This new system caused the emergence of a new school building, namely "Monitorial Schools". Much like factories, monitorial schools consisted of large halls or classrooms ranging from 24 to 30m in length and from 12 to 15m in width. (Knezevich, 1953) The children were seated along benches with desks, each row holding about 20 students. It was common to find classrooms with ten to twenty rows of students. Each row was divided into two "drafts" of approximately ten students, each under instruction of a monitor. The children would leave the benches at different times to go to "recitation stations," which were marked by semicircles on the floor along the room's sides and where monitors could provide "instruction" in the fundamental skills (Ibid).

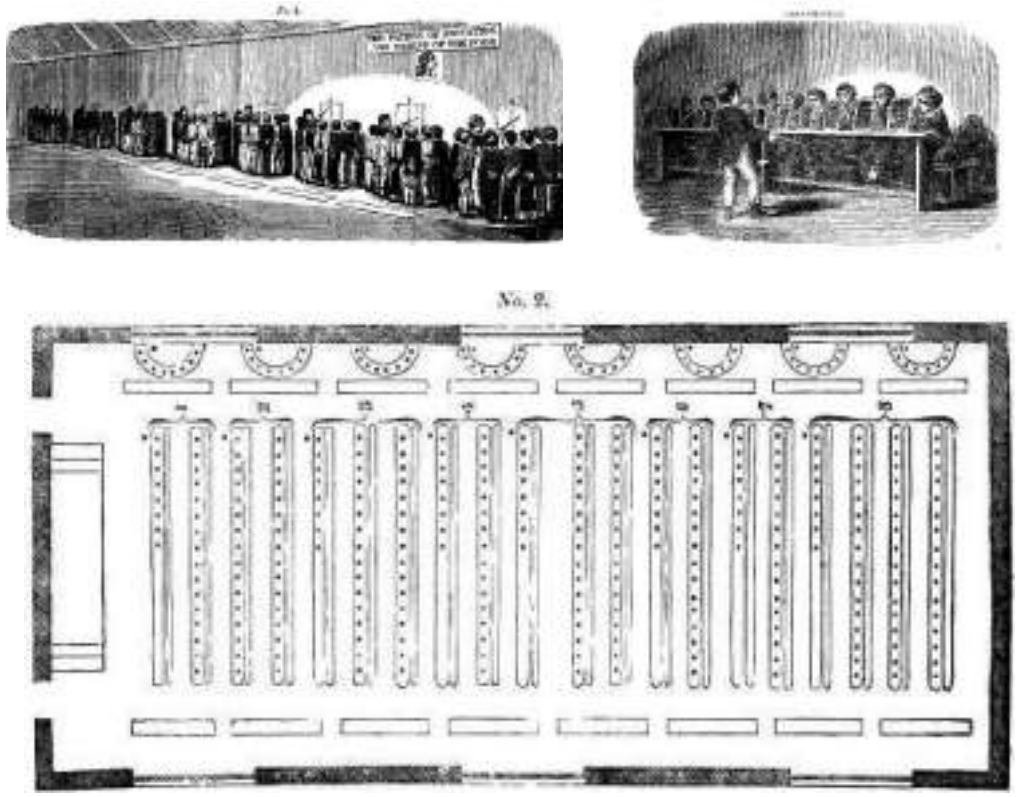


Figure 5: Monitorial School - Lancasterian Educational System (School, n.d.)

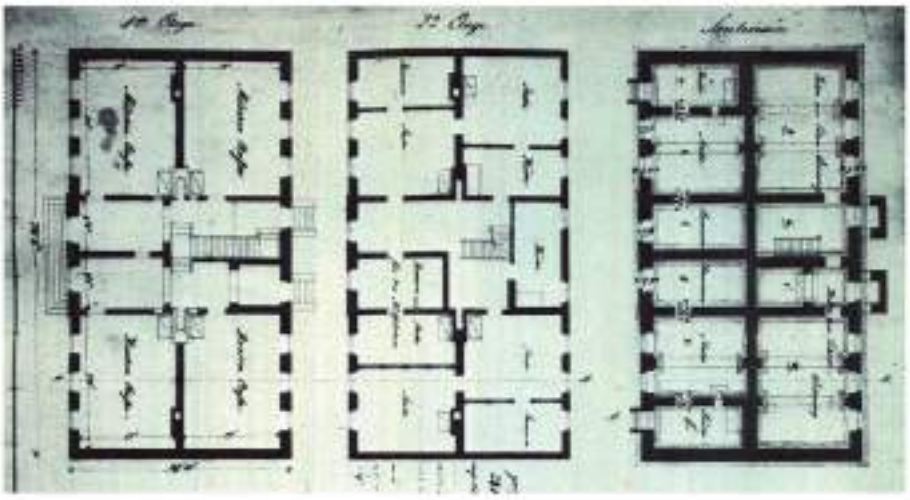
2.1.4.2. Prussian Prototype

The Prussian prototype, which complemented their ingenious educational system of the time, was the first building to take both pedagogic and administrative aims into consideration in the building layout. The number of classes per school were based on the growing number of enrolled students as well as the differentiation in school curriculum. They started with four classes (Figure 6), reaching eight classes (four for each gender), and then 12 classroom-schools in 1850, going hand in hand with a curriculum with six differentiated classes.

However, the higher curricular expectations, performance-oriented promotion and the growing number of enrolled students led to an overcrowding of the classrooms. This caused an increase of classrooms to 20 then 36 in number. Only eight of them were for the eight years of schooling, thus dissolving the connection between the number of classes per building and the number of successive classes.

The rising number of classes and pupils, backed by the pedagogical arguments, allowed for the construction of these larger schools, labelled “grand school buildings”. New facilities were added over time such as libraries, spaces for teachers and gyms.

Meanwhile the differentiation of the curriculum allowed for more specific teaching, which led to the incorporation of new subject-related classrooms. This building prototype set much of the standards that continued to be used in the centuries after, and up to this day.



"Floor plan for the Berlin common schools from 1827", in *Ein Bilder-Lese-Buch über Schule und Alltag Berliner Arbeiterkinder*, ed. Georg Rückriem (Berlin: Elefanten Press 1981), 22. School with four classes.

Figure 6: Berlin common school from 1827 (Isensee & Töpper, 2020)

2.1.4.3. Further Developments

In the United States, education took a very similar course to that of Europe. After Horace Mann's Common School Movement, that aimed at providing education for all social classes and religions, and his adoption of the Prussian Model in 1843, school architecture began to spread in the U.S.

The first graded school (Figure 7) was built in 1848 in Boston, Massachusetts, and is, according to Lackney "an oft-cited example of early factory model design principles whose design was replicated across the country through the 20th century" (Perez, 2017). The four-story school housed 660 students and featured 12 "single head" classrooms that opened onto common hallways. Individual desks were bolted to the floor in each classroom creating an "egg-crate setting", which measured 9.5 x 8m, a common dimension still present in modern classrooms. Each row contained eight desks, where the classroom consisted of seven rows, therefore holding a total of 56 students (Perez, 2017). On the 4th floor, the building held a large assembly hall for students, as well as the principal's office.

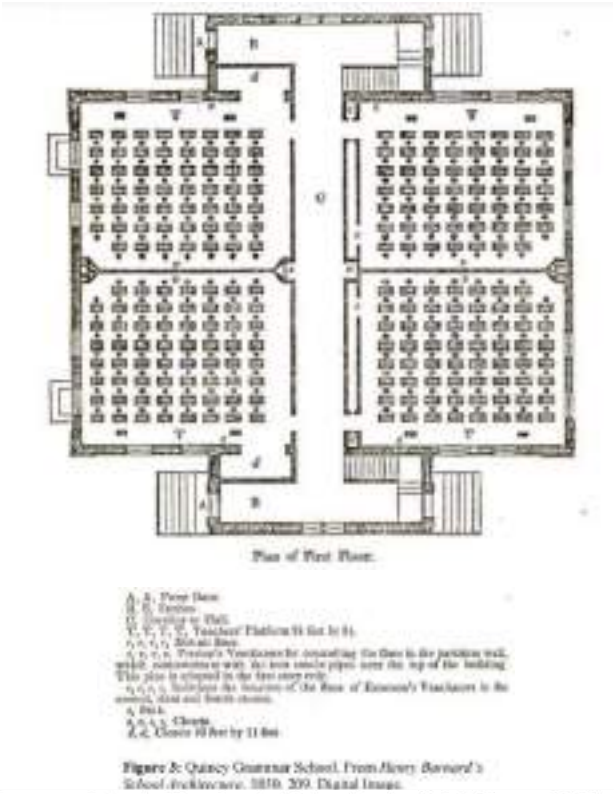


Figure 7: Quincy Grammar School - First Graded School in the U.S.A (Perez, 2017)

2.2. 20th Century School Architecture

2.2.1. Early 20th Century School Design

By the end of the 19th century, compulsory education had been adopted worldwide, and school architecture had taken the form of what was called "school palaces" in the urban contexts. They were typically made of brick and stood two to four floors high. Long central hallways were flanked on either side by high-ceilinged classrooms, resulting in buildings with depths of more than 20 metres (Châtelet & Gutman, 2018).

But with the growing concern of tuberculosis, the first wave of criticism was triggered. In 1904, the first international conference on school hygiene was held, exposing poor ventilation and sanitary installations in schools, as well as the

Figure 8: Perkins, Wheeler & Will with Eliel and Eero Saarinen, Crow Island Elementary School, 1940 (Anon., 2016)

lack of medical supervision. Doctors requested that light and air flow in, embracing the goals of the architects of the modern movement, which in Le Corbusier's words, were calling for "a new spirit", which was a building "like a receptable for light and sun" (Châtelet & Gutman, 2018).

Windows were widened, in some cases becoming sliding doors, rooftops were turned into heliotherapy terraces, and concerns on ventilation contributed to proposals for reduced building thickness. Hallways were to have classrooms on only one side. This resulted in many school design proposals such as the Open-Air Schools and the Finger Plan (Figure 8,9,10) with classrooms that were very well lit, ventilated and had direct access to the outdoors.

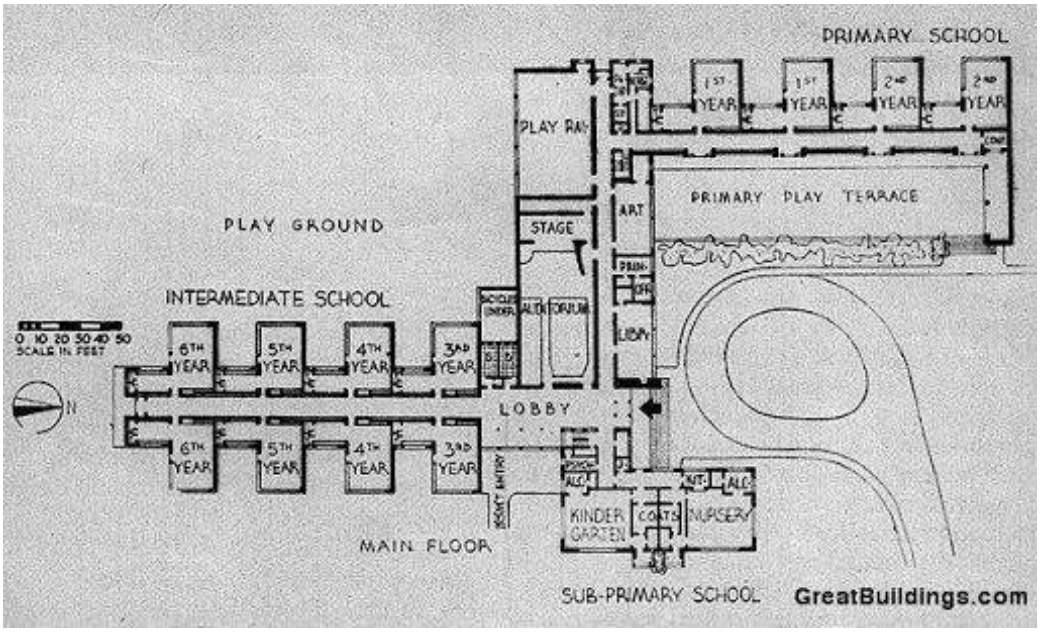


Figure 9: Perkins, Wheeler & Will with Eliel and Eero Saarinen, Crow Island Elementary School. Source: Great Buildings - Crow Island Elementary School floor plan, 1940 (Anon., 2016)

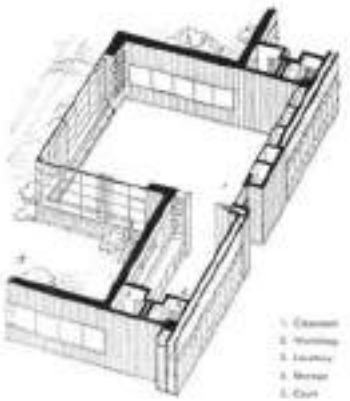


Figure 10: Crow Island School axonometric drawing illustrating a typical classroom pod (Lackney, 2015)

2.2.2.Mid to Late 20th Century – Post WWII School Design

In the 1950s, after the destruction caused by the war and the emergence of a baby boom, there was an urgent need to re-construct and expand school buildings to accommodate the population increase. Between 1946 and 1964, about 77.3 million babies were born in the U.S only (Holst, 2008), and about 11 million children entered the educational system (Perez, 2017). Therefore, the immediate need for new school buildings led to changes in school building standards, and the need to minimize expenses and erect buildings quickly led to a standardization of school designs.

Unlike earlier public schools, postwar schools were designed to be more practical and functional than conventional two- to four-story brick schoolhouses. Steel framing, plate glass, and low-rise horizontal massing were all used. As a result, schools are less costly and easier to build. The increasing spatial and financial needs of school districts led to a mass standardization of school designs that focused on the building's physical structure, expense, and function (Perez, 2017).

Several movements of school design followed, including the Open-Plan School (Figure 11) in the 1960s and 70s where classrooms were divided into learning areas with their own topic or subject, or in other schools dividing a larger room into sections for each subject. Jeffery Lackney described them saying, "these schools were planned with large, open, flexible spaces adaptable to team teaching as well as small-group and individualized instruction that characterized open education" (Perez, 2017). The Open-Plan environment was believed to encourage self-direction and self-motivation in students, which would "lead the pupil to be more creative, self-assured, intellectual, and understanding. Yet due to lack of systematic training, as well as noise and visual distraction, this school prototype was abandoned (Perez, 2017).

Open Plan Concept Diagram of The Dewey School in Chicago. C. William Brubaker, From *Schools for the Future*, 33.

Figure 11: Open Plan Concept (Perez, 2017)

According to R. Thomas Hille, the 1980s mainly consisted of a basic reconsideration of educational experimentation in the 1960s and 1970s, as well as a renewed focus on fundamental academic subjects like math, science, and the humanities, preferably taught in more traditional educational venues (Baker, 2012). School buildings from the 1940s-50s were also in need of renovations and replacement, but as enrollments were declining, little investments were directed towards them, and the pace of new school construction slowed (Baker, 2012).

By the end of the 20th century and the rise of technology, many new movements made their way to school building design. The first movement of the 1990s was that of the

"learning communities". Based on a growing consensus in the research literature, there was a growing interest in the development of new smaller schools and the restructuring of older school buildings into schools-within-schools (Lackney, 2015). According to educational research, small schools have higher engagement in school events, extracurricular activities, student satisfaction, social connectedness, and achievement. This theory led to the design of school wings in the form of cluster classrooms (Figure 12) to hold 100-120 students and their teachers. Spaces were personalized, self-directed including variable and flexible sized spaces as well as individual workspaces. Some of the collaborative learning spaces included galleries, studios, informal study spaces, lounges, and outdoor spaces (Perez, 2017).

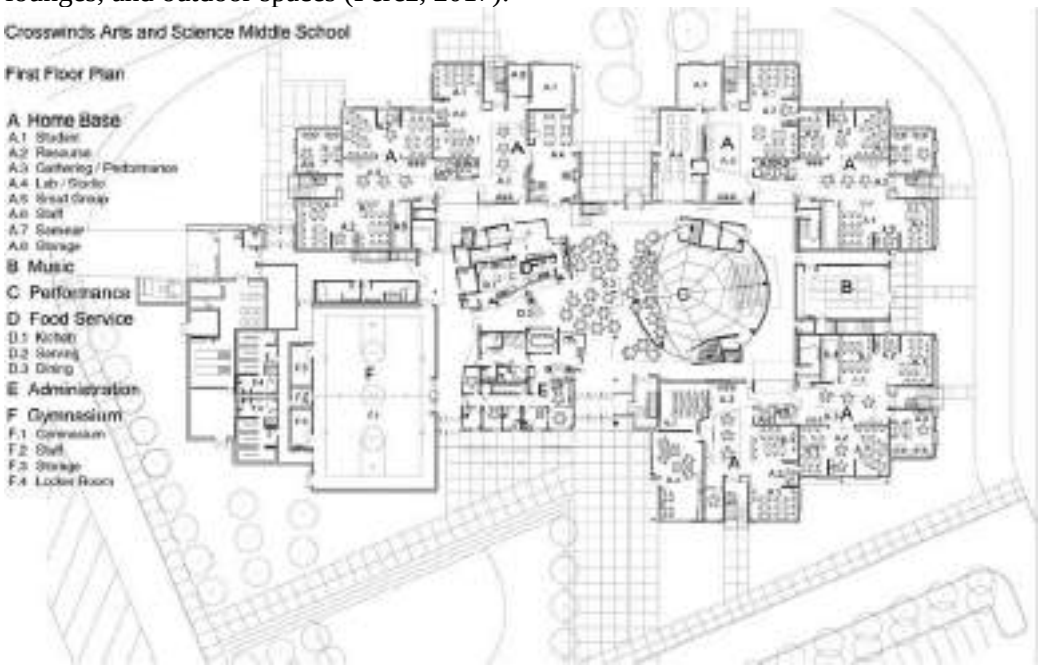


Figure 12: Crosswinds Arts and Science School multi-age plan portraying "Learning Communities" movement (Lackney, 2015)

The end of the 1990s and the new millennium brought further development of information and communication technology, and with the spread of the internet, education became possible beyond the school building walls (Perez, 2017). Access to information was easier and the provision of online education to populations far from the school geography. This movement is increasingly present until this day and was named the "Virtual School" (Lackney, 2015).

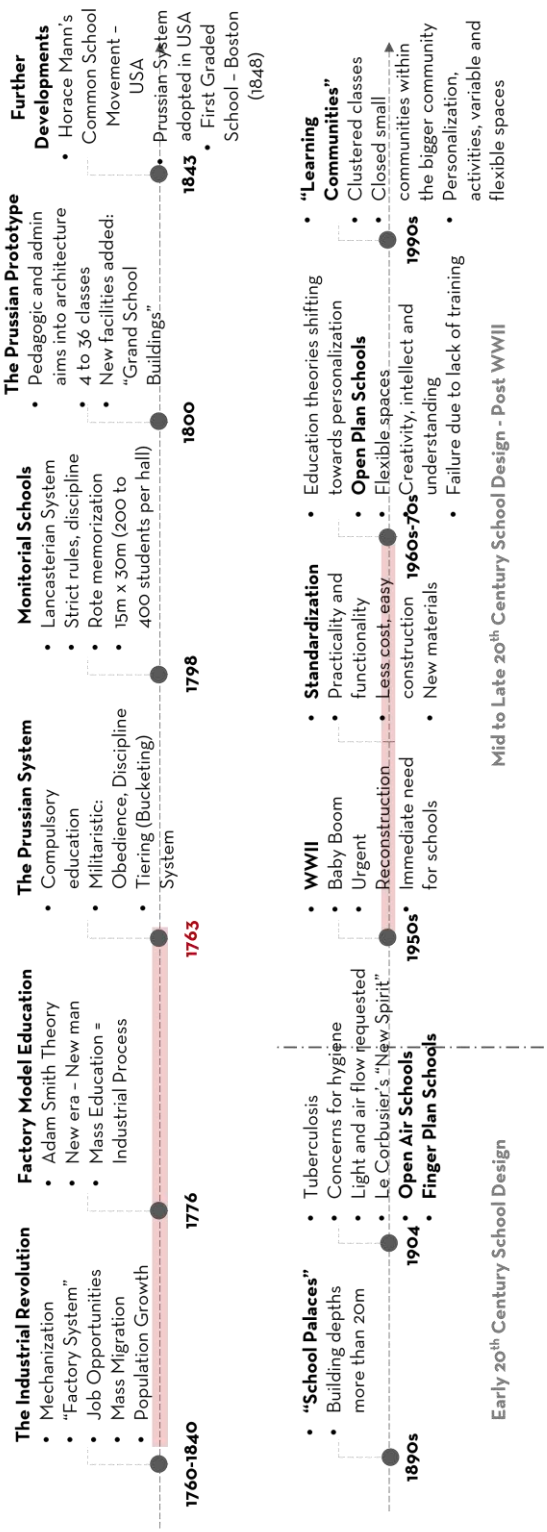


Figure 13: History of School Architecture - Global Scale

2.3. Evolution of Schools in Egypt

2.3.1.1952 – 1970: Gamal Abdel Nasser

In 1952[1], post-WWII, Egypt had been suffering a deteriorated state of the country due to the corruption of the monarchy and its associations with the British Occupation which had taken over the country since 1882. A group of army officers, known as the "Free Officers" began a revolution. It aimed at:

a) Overthrowing the corrupt monarchy with all its associations with the British occupation
b) Reforming the military
c) Gaining control over governmental sectors and capital
d) Social welfare and enhancing Egyptians' quality of life.
e) Democracy
f) Liquidation of differences among various layers of the Egyptian society by redistribution of public and private properties

Nasser, who was one of the two leaders of this revolution, led 89 other Free Officers in an army coup that deposed the regime of King Farouk and established a new government. In 1956, he was voted the first president of Egypt. (Editors, 2019). He governed as an efficient and popular leader and promulgated a new constitution that made Egypt a socialist Arab state, consciously non-aligned with the world's predominant communist and democratic-capitalist regimes.

Promoting his vision of Arab Socialism, which is also known as "Nasserism", Nasser worked on the nationalization of all public and private sectors. A reform in administration, health and education began, where he constructed hospitals in rural areas for the provision of better health conditions, and provided job opportunities in Cairo, which led to mass internal migration.

He also took interest in public schooling and education, aiming at reclaiming education from the British power. In 1956, he passed laws which enlisted:

a) Cancellation of Kuttabs[2]

b) Cancelling English teaching in primary schools and teaching in Arabic

c) Primary education extended from 4 to 6 years.

[1] Before 1952, Egypt was under the occupation of many successive rulers. This lasted for 1500 years, from the 7th century until the mid-20th century. Therefore 1952 marks the year Egypt became a Republic, and the beginning of modern history and Egyptian governing.
[2] Kuttabs: A main center of education which began in the Islamic Era in Egypt, teaching boys ageing from 5 to 14 years old how to read, write, and recite the Quraan, preparing them for the next phases of education. (Abdel Hady, 2015)

d) Splitting of secondary school to preparatory (3 years) where children start learning English, and secondary (3 years) which ends with a unified exam in preparation for higher education.

The curriculum remained as was placed by British experts during the occupation due to the lack of qualifications to place a new one (El Fiky, 2019).

In 1956, Nasser nationalized the British and French-owned Suez Canal, intending to use tolls to pay for his high dam project.

His popularity sky-rocketed after this. He began reforms on land, economy, and education. In 1958, he began the nationalization of most English schools, and the royal family's palaces, turning them into educational spaces and schools (Figure 14).

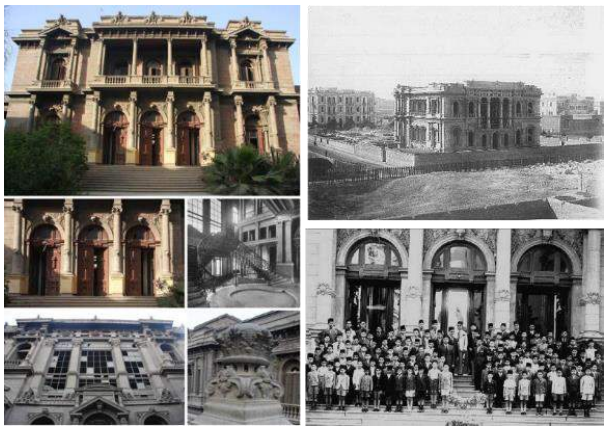


Figure 14: Said Halim Palace est. 1939 - Nasiriya School for Boys

"The 1950s–60s witnessed an outstanding quantitative growth in educational infrastructures and literacy, especially in the provincial and rural areas neglected by the ancient regime. 'Educative Nasserism' attempted to reduce broad gaps in the spatial hierarchy, such as between north and south or urban and rural milieus" (Makar & El shahed, 2019). Though inequalities certainly endured, populations with low initial rates of literacy benefited the most from these policies. But for this to happen, new facilities across the vast geography of Egypt had to be constructed quickly, and so architects provided the plans for standardized school models, such as Model 10 (Figure 15)**,** which

Figure 15: Nasser's Model 10 School (Makar & El shahed, 2019)

created modern spaces for education in cities and rural areas and overcame the challenge of overhead costs.

372 new schools were built on previously agricultural lands, acquired by the state for the public good. "While inspired by international architectural developments of the time, the school's standardized modernist and functionalist design served the purpose of the centralized state's provision of universal primary education across the country, regardless of local specificities" (Makar & El shahed, 2019). They were efficient to assimilate a new generation of Egyptian youth into revolutionary state's vision of nationalism, socialism, and revolution.

Architect Tawfiq ʿAbd al-Gawwad, for example, wrote:

> *"A noble outcome of the revolution, and one of the most important goals of the revolution, is to provide education with ease to millions of the children of the nation in new healthy schools, not only to learn reading and writing but also to be transformed into good standard citizens [muwatenin salhin], strong and capable of working, with hearts full of love for Egypt."* (Makar & El shahed, 2019)

The standardized school design which had been designed by architects and engineers from Cairo consisted of a two-story building, later reaching four stories (Figure 16), contained thirteen classrooms for boys and girls, a meeting room, teacher rooms, a prayer room, storage rooms for food and school supplies, as well as gender-segregated bathrooms housed in a separate structure. This prototype resembled the early 19th century characteristics that had been adopted worldwide, as well as the post-war standardization of schools' movement.

With their desks lined up facing the blackboard, classrooms measured five and a half by eight metres (Figure 17) and could accommodate forty-two students. A portrait of President Nasser hung above it, the supreme authority figure, and a constant reminder to students that they were living in a new age. The conference room was elevated on slender columns, with a shaded play area underneath it, and all the classrooms faced north with large windows for cross ventilation and natural light (Figure 18) (Makar & El shahed, 2019).

Figure 16: Plans of Model 10 - Mixed Gender School (Hegazy, 2012)

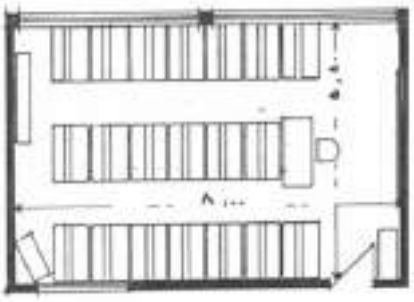


Figure 17: Standard Classroom Plan (Hegazy, 2012)

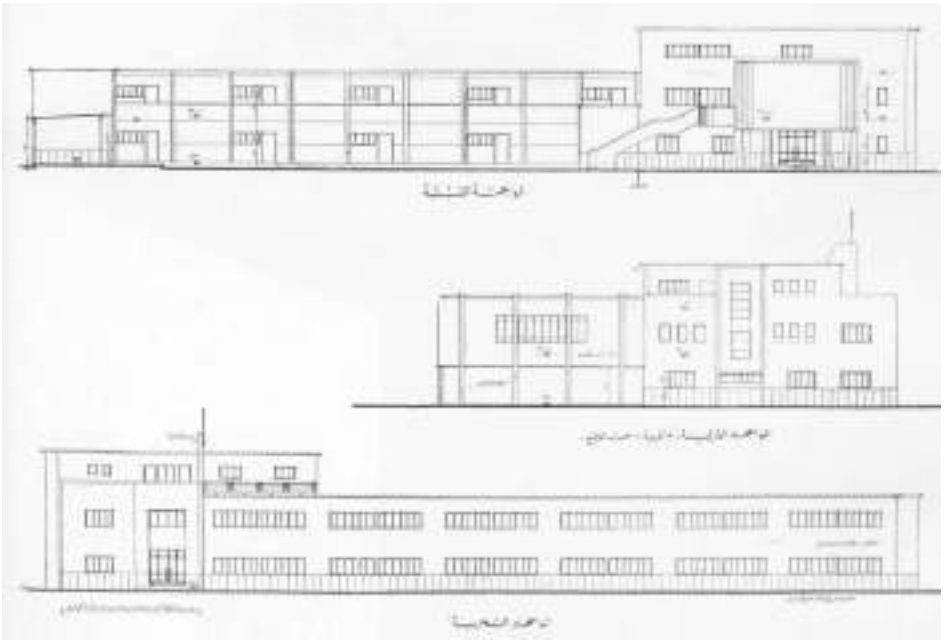


Figure 18: Elevations of Standard School Building (Makar & El shahed, 2019)

In 1958-59, new revised textbooks were published for all subjects, adapted across the country meant to indoctrinate the student population with nationalism. They remained in use for much of the 60s and 70s. Due to the limited number of schools, evening classes systems was introduced, some schools working 3 periods, therefore capacities became higher than normal. This movement of mass education continued when higher education became free of charge in 1961, and the nationalization of universities took place. (Abdel Hady, 2015).

2.3.2.1970 – 1981: Anwar El Sadat

The scale of the Arab defeat in the Six-Day War of 1967 damaged the standing of Nasser and the ideology associated with him. Though it survived Nasser's death in 1970, certain

important tenets of Nasserism were revised or abandoned totally by his successor Anwar El Sadat during what he termed the "Corrective Revolution". Sadat shifted Egypt's economy from a Leftist to Rightist ideology, from Socialism to Capitalism. Even political unions and alliances shifted from the Soviet Union to the USA and Europe, especially after the 1973 war with Israel and the Egypt-Israel peace treaty.

In 1974, Sadat established his Open-Door Economic Policy (ODEP), also known as "Infitah" in belief that capitalist economic policies would build a substantial private sector, and alliance with the United States and the West would lead to prosperity and eventually democratic pluralism. Through it he aimed at:

a) Revitalization of the private sector

b) Opening the country's doors to the flow of foreign and Arab capital / investment

c) Partial dismantling of the public sector

d) Reversing Egypt's socialist transformation

ODEP encouraged investment in all industries, as well as education. Businessmen began investing in education, opening many schools where students could learn the governmental curriculum, but with tuition fees (private schools) in return for the entertainment services provided by the school and the low number of students per class. Other businessmen opened schools that taught all subjects in English for higher tuition fees which was the first emergence of Language schools. The new economic system attracted foreign investment as well, therefore creating a market and workforce that needed language for communication. That was why in the mid-70s, public schools with tuition fees were founded to provide English education to the middle class to ensure their learning of language to deal with foreigners who had entered the Egyptian Market. They were named Experimental Schools (Figure 19) (El Fiky, 2019). Designed with almost identical layouts to Nasser's Model 10, they represented a new prototype building of a school around all governorates in Egypt.

Figure 19: Experimental School Building Prototype (Nessim, n.d.)

Therefore, as a result of the ODEP, schools split into several prototypes some of which were private while others publicly owned by the government. They presented the public with different options in learning language and for different social classes, yet all taught the governmental curriculum.

2.3.3.1981 – 2011: Hosni Mubarak

Mubarak became president after Sadat's assassination in 1981. From 1991, he undertook an ambitious domestic economic reform program to reduce the size of the public sector and expand the role of the private sector. During the 1990s, a series of International Monetary Fund arrangements, coupled with massive external debt relief, helped Egypt improve its macroeconomic performance. However, this growth was far from evenly spread. Monetary restructuring, especially the flotation of the Egyptian pound, the liberalization of the country's money markets, a reform of the tax system and strategic reductions in governmental social spending, resulted in "staggering hardships for the majority of the people". Capitalism continued to grow, and investments were made in all industries.

An increase in the number of students wanting to be educated in Language schools occurred due to the decrease in quality of education of public schools, therefore encouraging businessmen to establish new language schools.

Figure 20: Canadian International School of Egypt (CISE, n.d.)

Upon emergence of the new century, globalization and technology were trending, and the English language dominated the world. A worldwide free-market economy spread globally, making it possible for Egyptians to work anywhere in the world. Therefore, in 2002, the first international school was opened in Egypt, teaching a Canadian curriculum (Figure 20). It did not fall under the authority of the government due to being privately owned and led to further social segregation where only the extremely rich could afford to enter such schools to follow Western developments.

This was followed by a string of international schools emerging (American, French, German, British, Canadian), each promoting their respective curriculum. Therefore, multiple school types and multiple curricula spread in Egypt, and the division of social classes increased in education where the poor class depended on public schools, the middle class on Experimental and Language schools, and the rich class on international schools. This encouraged some language schools to split into two parts: National and International. In 2010, the government founded a public international school called Nile Schools, to give opportunity for quality education to the middle class. The Ministry of Education also passed a law that Arabic, Religion and Civics would be taught even in the international curricula.

Yet the rapid economic growth, privatization and monopoly of industries led to a wide gap in the distribution of wealth and economic return, high rates of unemployment and poverty. These conditions, accompanied with political corruption, censorship, electoral

fraud, and the application of state-of-emergency laws sparked the 25th of January Revolution in 2011, which led to Mubarak's step down and the uproot of his system.

During that time of shifting ideologies and a promising new beginning, the USAID partnered with the Ministry of Education envisioning a new education. They wanted to change the stagnant status of Egyptian education, characterized by outdated curricula, traditional methods, factual knowledge, and theory. Therefore in 2012, the first two STEM high schools opened (Figure 21), aiming to develop Science, Mathematics, Engineering and Technology, which are the main fields required to enhance the country.

Figure 21: STEM School, El Menoufia (Elgazzar, 2017)

2.4. Egypt: Schools of Today

Between removal of Mubarak's regime, the uprisings, the elections, the period of Mursi and the Muslim Brotherhood, and the Egyptian Military supporting the people in 30th of June uprising, Egypt went through a long period of instability and endless social and economic challenges. These challenges lasted until 2014, when Abdel-Fatah El Sisi won the presidential elections. Due to the large damages done, political instability remained until 2015, when El Sisi began his reforms and efforts in stabilizing the country's politics, economy, and security.

In 2014, a plan was set for educational reform "Strategic Plan for Pre-University Education 2014-2030" due to its stagnancy, overcrowded classrooms, high student to teacher ratio and low-quality teaching in public schools. 13 more STEM schools opened all over Egypt, and there was a rapid increase in the number of international schools. Rehabilitation of public-school buildings also began to take place, as well as teacher training programs. The incorporation of technology in classrooms increased, for example the installation of smart boards and using iPads for learning, and with the emergence of COVID-19 virus, this initiative was accelerated and enhanced by providing services such as the EKB[3] and online education platforms.

In 2016, the government began an education partnership with Japan to open Egyptian-Japanese schools. Between the years 2018-2019, 35 schools opened in 21 governorates, and are planned to expand to 200 schools. These schools aim to improve students' education. "Classrooms will hold only 25 students, aiming at building children's

[3] The Egyptian Knowledge Bank, launched in 2016, is a platform that provides all Egyptian citizens with online access to quality research and educational resources (eBooks, periodicals, and media) nationwide. (AUCEgypt, n.d.)

personalities, establishing a balanced social development, emotional and academic aspects and raising the education level" (EgyptToday, 2017).

Therefore, the building types existing today are those of the governmental schools, whether public Arabic schools or Experimental schools that still adopt the architectural design of Nasser's Model 10. Language schools do not differ much yet provide more facilities for extra-curricular activities. STEM schools are designed to correspond to their curriculum, with informal spaces promoting active learning and constant connectivity. International schools are designed to respond to their pedagogy, providing children with a balanced education, activities, and entertainment facilities. These mainly follow the curriculum of the international system adopted, its methods, vision, and needs. Finally, the newly found Egyptian Japanese Schools.

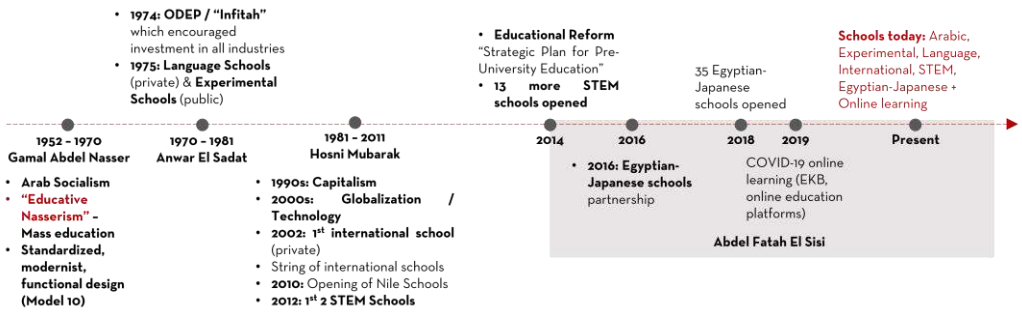


Figure 22: Evolution of Schools - Local Scale

2.5. Egyptian Education System

In the light of these reforms and governmental efforts to enhance education, it is important not only to develop curricula and construct new schools, although both are vital, but also to evaluate our pedagogies and the skills that Egyptian education promotes. This is extremely important so that the defects of the system are understood to be addressed.

The Egyptian educational system (Figure 23) consists of two phases: basic education and secondary education. Basic education, which is free and compulsory, is composed of six years of primary school, and three years of preparatory school, student ages ranging from 5 to 15. Secondary school is optional, and splits into two types: general and technical secondary education. As previously mentioned, Egyptian education also holds both National and International systems, with the national system subdivided into Arabic Schools (governmental), Experimental Schools (governmental) and Language Schools (private), while International Schools are all privately owned and follow different international curricula. Consequently, the focus of this paper will be on National System Schools; Arabic and Experimental, since they are governmental and the most common. It will further focus on Primary level education because it is considered basic education and is mandatory in Egypt, holding the highest percentage of net enrolment of 96.9% (UIS, 2019). The curriculum of the primary stage includes general subjects like Arabic,

mathematics, social studies, and science. In Arabic governmental schools, the curriculum is taught in Arabic, and English is taught from grade one. In Experimental schools, teaching is conducted in English, where other foreign languages are introduced in the preparatory stage. Yet these schools admit children at the age of 7 years old, older than those of Arabic schools. Language schools teach the same governmental curriculum yet begin teaching English and foreign languages in the primary stage. They also teach A level English language. They are mainly the same as other schools but pay more attention to the students' personal needs and to the school facilities since they charge tuition fees.

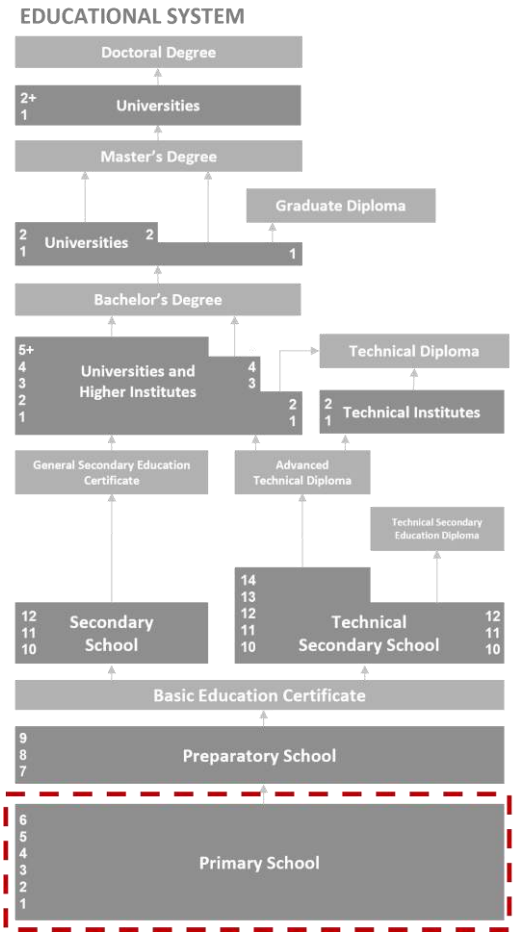


Figure 23: Egyptian Education System (Mohamed, et al., 2019)

The Egyptian education system mainly depends on memorization and examination. "Rather than being encouraged to engage critically with the subject matter at hand, students are generally steered towards memorization and rote-learning" (Loveluck, 2012) .

Like the Industrial Era schools, learning is a one-way process based on teacher-delivered knowledge assuming that all children learn the same way and at the same pace. This method of teaching, which originated in the 18th century, and was altered in the 20th century after the war, continues up to this day. Therefore, it was given the name "20th century education".

Conclusion

Mapping out the history and evolution of school architecture globally and locally, it can be concluded that school buildings have followed the economic and political shifts happening in the world. Due to these shifts, visions of nations were created, and in turn school architecture served to supply these visions with the workforce. The differing ideologies of education mirrored the needs for each era, further being reflected in the school physical design.

School design transformed from “the factory”, to promote education of the masses in the Monitorial school, shifting afterwards towards military-like education in Prussia, which was based on obedience and diligence, reaching the graded prototypes that are still built today in the mid-1800s. With the rise of the 20th century, many movements appeared incorporating the different eras’ needs and concerns, yet with the aftermath of WWII standardization overruled.

During that period, Egypt was facing its own challenges of the 1952 Revolution, and mass education and nationalization were severely needed, therefore this ideology was adopted. While several school types appeared since the 1950s, Egypt’s schools today still face mass standardization, promoting 20th century learning in the 21st century. But what exactly is 21st century learning? This is to further be explored.

21st Century Learning

Since the beginning of the 21st century, the world has been evolving at an unprecedented rate. Technology has taken new dimensions, and economies have shifted their scope. Visions of nations and needs are shifting every day. Change has become unpredictable. Since education has always mirrored the needs of the eras, it is crucial that the needs of the 21st century are understood, and that children are prepared to deal with unpredictability and change. Since careers no longer require specialised skill sets and a thorough understanding of a single domain, it has become difficult to stay at a single career-path for decades. Due to the rapid advancements in technology such as automation, entire industries are shifting. That is why students must be taught to develop a broad range of skills that can be applied in any professional setting. Therefore, it is essential that learning shifts to meet the needs of the 21st century, reinforcing children with the skills they need to adapt to today's fast-paced world.

3.1. 20th VS. 21st Century Learning Demands

In his book "*Out of Our Minds*", Sir Ken Robinson stated that "the more complex the world becomes, the more creative we need to be to meet its challenges" (Driscoll, 2017). He pointed out that "human life is characterized by diversity", and that each child has his own personality, strengths, and weaknesses, which can be vastly different. Despite this, education does not recognise the inherent diversity of the human population (Schwartz, 2016).

Because 20th century education followed the needs of the industrial economy, it mainly depended on standardization, of both learning methods, as well as the physical setting of schools. Consequently, it narrowly defined success through a certain type of achievement – academic work – and that made it overlook what other things children might be good at. It focused on providing children with specific amounts of knowledge through memorization and repetition and testing their ability to remember it. Yet is this what children need to cope in today's world?

The modern economy of the 21st century bears no similarity to the previous industrial factory-based economy. "Today's economy is a knowledge-based economy based on the manipulation and transmission of knowledge" (SEG, n.d.). The current generations are very different from even those of the previous decade. They have grown up with technology around them rather than being forced to learn the technology later in life. They are native to the digital era, where information is at the tips of their fingers. It is no wonder that many students have little patience for the typical school environment with its slower pace, high structure, and reliance on teacher-directed instruction (SEG, n.d.).

While industrial societies required factual or procedural models of knowledge (Joynes, et al., 2019), the world today no longer needs people who are capable of memorization. For children to be prepared to face the modern world around them, they must be fortified with the skills necessary to succeed in this era of new scientific discoveries, informatization, globalization and artificial intelligence. The world needs creative people who can think critically, and individuals capable of quickly adapting to increasingly evolving globalised social and economic models. "Students need the skills to efficiently discover, analyse, and communicate information as it grows at an incredible pace." Because knowledge is easily accessible, "it is the analysis, evaluation, and application of knowledge to solving problems that has taken centre stage" (SEG, n.d.).

Therefore, while 20th century learning depended on teacher-directed instruction, knowledge, providing children with basic skills, individual learning, and learning through theory, 21st century learning focuses on student-centred education, collaborative instruction, focusing on skills instead of knowledge, teaching through practice. Learning for school versus learning for life. (Figure 24)

20th Century Learning	21st Century Learning
Teacher-directed	Learner-centered
Direct instruction	Collaborative instruction
Knowledge	Skills
Content	Process
Basic skills	Higher-order thinking
Theory	Practice
Individual	Group
Curriculum	Life skills
Individual	Group
Summative assessments	Formative evaluations
Learning for school	Learning for life

Figure 24: 20th VS. 21st Century Learning (Stipich, 2015)

3.2. 21st Century Skills

Partnership for 21st Century Learning (P21), a leading advocacy organization based in the USA, is currently focused on infusing 21st century skills into education (Figure 25) (P21, 2019). Over the past decades, education has been based on teaching students the "3 R's" which are reading, writing and arithmetic as well as some simple subjects in social studies and language (Alismail & McGuire, 2015). Yet these are not enough. P21 stresses that students must also learn the essential skills for success in today's world (P21, 2019). They defined 21st century skills as "the core competencies that schools need to teach to help students thrive in today's world" (Allington, 2010). P21 then divided these skills into three categories**: Learning skills, Literacy skills, and Life skills**. (Figure 26)

Figure 25: Framework for 21st century learning (P21, 2019)

3.2.1. *Learning skills (the 4Cs)*

They are the skills universally needed for any career. They educate students on the mental processes needed to adapt to and improve in today's workplace.

The 4Cs are:

a) **C**ritical thinking: the capability of objective analysis of information and problem solving.
b) **C**reativity: the ability to explore and create fresh ways of thinking. The new way of seeing or doing things (Thinking outside the box). Innovation.
c) **C**ollaboration: the ability to effectively work together with others.
d) **C**ommunication: the ability to express one's opinions, desires, needs, apprehensions (CBSE, 2020) .

Figure 26: 21st Century Skills by P21 (Partnerships for 21st C. Learning) (Stauffer, 2020)

3.2.2. Literacy skills (IMT)

They are the skills involving the ability to access information (traditional or digital), media and technology, to understand and critically evaluate different aspects of content and information and create and communicate effectively (CBSE, 2020). “There is a strong focus on determining trustworthy sources and information to separate it from the misinformation that floods the Internet” (Stauffer, 2020).

a) **I**nformation Literacy: Understanding facts, figures, statistics, and data.
b) **M**edia Literacy: Understanding the methods and outlets in which information is published.
c) **T**echnology Literacy: Understanding the machines that make the Information Age possible (Stauffer, 2020)

3.2.3. Life skills (FLIPS)

They are the skills required to lead a personal successful everyday life, yet also affect one’s professional setting.

a) **F**lexibility: a person's ability to adapt his acts and steps in response to a changing situation
b) **L**eadership: the ability to lead a team and manage a team effectively in the face of real-world challenges
c) **I**nitiative: the ability to begin a task independently
d) **P**roductivity: the ability to fulfil any task within a given time
e) **S**ocial skills: the ability to interact, collaborate, and operate efficiently in a variety of social and cultural situations (CBSE, 2020)

Altogether, these categories cover all 12 21st Century Skills that contribute to a student’s future career.

3.3. Importance of the 21st Century Skills

The 21st century skills have become essentially important to achieve the education required for current and future times. “Today, because of rapid economic and social change, schools have to prepare students for jobs that have not yet been created, technologies that have not yet been invented and problems that we don't yet know will arise” (CBSE, 2020). In addition to that, teaching specific

knowledge only to test has become outdated, since it does not help children face everyday life situations. Consequently, teaching them skills is the key to their empowerment, to deal with their issues, careers, and lives, helping them navigate through a world where they will always be subjected to new challenges.

This in turn will enhance their ability to find out what each child is specifically and uniquely good at, and what they can offer to their societies and countries, without their creativity and individualism being squelched or taken for granted as part of the crowd. The aim is to prepare today's student to be a successful citizen and responsible human being who recognises his own abilities and potential. As a result, it is critical that these skills are integrated into educational systems all over the world because they present learning as a comprehensive and holistic model in which students can effectively perform and fulfil their obligations to themselves, their school, their families, community, and their country.

3.4. Which skills at what age?

In 2020, a study was conducted by the Central Board of Secondary Education (CBSE) in Delhi, India, on the "Need and Inter-Connectedness of 21st Century Skills at Various Age-Levels". Based on the recommendations stated in the National Curriculum Framework (NCF) 2005, and several discussions held at various forums, they concluded a table showing the mutual connectedness of Core Life Skills (given by WHO in 1999) and other components of the 21st Century Skills for the development of an individual's self at various age-levels (CBSE, 2020).

Age	Dimensions of Self of an Individual	Core Life Skills	21st Century Skills
3-5 years	Understanding and Expressing Self	Self-Awareness	Communication
	Enhancing Self	Problem Solving	Critical Thinking, Communication
	Building and Maintaining Relationships	Managing Emotions	Communication, Social Skills, Creative Thinking, Flexibility
6-10 years	Understanding and Accepting Self	Self-Awareness, Effective	Critical Thinking

		Communication, Decision making	
	Managing and Expressing Self	Self-Awareness, Effective Communication, Managing Emotions, Critical thinking, Decision Making, Problem Solving	Collaboration, Adaptability
	Enhancing Self	Self -Awareness, Effective Problem Solving	Collaboration, Communication, Critical Thinking, Creative Thinking
	Building and Maintaining Relationships	Empathy, Interpersonal Relationships, Problem Solving	Critical Thinking, Creative Thinking, Communication, Initiative
11-13 years	Understanding and Accepting Self	Decision Making, Self-Awareness, Problem Solving	Critical Thinking, Creative Thinking, Collaboration, Effective Communication
	Managing and Expressing Self	Self-Awareness, Managing Emotions, Decision Making, Problem Solving, Empathy	Communication, Creative Thinking, Collaboration, Critical Thinking, Information/Technology/ Media Literacy
	Enhancing Self	Self-Awareness, Decision Making, Problem Solving, interpersonal Relationships, empathy	Communication, Creative thinking, Critical Thinking, Flexibility, Initiative, Productivity
	Building and Maintaining Relationships	Self-Awareness, Managing Emotions, Empathy, Interpersonal Relationships, Decision Making, Problem Solving	Critical Thinking, Effective Communication, Creative Thinking

14-18 years	Understanding and Accepting Self	Self-Awareness, Decision making, Problem Solving, Managing Emotions, Empathy	Collaboration, Critical Thinking, Creative Thinking, Communication, Information/Technology/ Media Literacy
	Managing and Expressing Self	Empathy, Self-Awareness, Managing Emotions, Problem Solving, Inter-personal relationships	Critical Thinking, Communication, Creative Thinking
	Enhancing Self	Self-Awareness, Decision Making, Problem Solving, Interpersonal Relationships, Empathy	Communication, Creative Thinking, Critical Thinking

Table 1: The mutual connectedness of Core Life Skills and 21st Century Skills for the development of an individual's self at various age levels (CBSE, 2020)

Taking a closer look at the study conducted by CBSE, it can be observed that the main skills that cover the age group of primary schools (5-11 years), which this paper will be focusing on, are the 4Cs of the 21st century skills. While the Literacy and Life skills are interwoven throughout the phases, proving that all skills are mutually connected and interlinked, the main weight lies in the Learning skills. This presents great convenience since Learning skills can easily be taught in schools and starting a very young age. Therefore, throughout the paper, analysing the school buildings will mainly be through studying the physical aspects that achieve all 21st century skills, mostly the 4Cs.

Conclusion

After studying the differences between 20th and 21st century learning and understanding the main pillars of what 21st century learning promotes, it can be concluded that the main aim of this new ideology is to prepare children for their careers and lives, reinforcing them with a variety of skills that they can adapt to different fields of work and life. This is essential because the changes happening in the world are unpredictable and extremely rapid. Therefore, 21st century learning prepares children for unknown futures and careers that have not been invented yet.

This in turn, must reflect on pedagogies and school design, so that these skills are made possible by the physical environment they are promoted from. While this chapter focused on understanding 21st century learning and its importance, the next chapter will portray the physical manifestation of this ideology in school building design.

21st Century Schools

4.1. 20th VS. 21st century School Buildings

As portrayed previously throughout this paper and shown in the prototype school buildings we have today, Egypt's schools mostly follow the standardized industrial prototype that was founded in the Industrial Era and post-WWII. Long corridors flanked by standard "egg-crate" classrooms with rigid, individual seating. Strict control is applied to students to achieve education of large capacities. The building design is driven more by convenience than by education with no individualization or personalization. Standardization of the governmental school is still ongoing to minimize expenses and time, with no regard to specifics such as orientation or context.

While successful at its time in providing the needs of that era; mass education, crowd control, diligence, obedience, and factory skills, this 20th century school building has become outdated in serving the needs of the 21st century. According to Sir Ken Robinson, the two main pillars of 20th century education were "compliance and conformity" (Schwartz, 2016). This is clear in the rigidity of the spatial design of the building as well as the methods of teaching, which were designed for control of both students and teachers. Yet today, control is no longer the fundamental factor shaping school buildings.

Since 21st century education focuses on skills rather than memorization, a strong factor of personalization is required. Educational models have been shifting from teacher-based to student-based learning. School buildings have been renamed "Learning Spaces", (Stadler-Altmann, 2018) or "Learning Environments", (Stillar, 2012) losing the definition of the traditional building full of enclosed classrooms with inflexible seating, to a place where learning can be found anywhere (IDB, 2012). This resembles the Learning Communities movements of the 1970s and the 1990s.

Learning environments have been defined in many ways, such as "the diverse physical locations, contexts, and cultures in which students learn." (McGill.CA, 2019) Since students may learn in a wide variety of settings, such as outside-of-school locations and outdoor environments, the term is often used as a more accurate or preferred alternative to classroom, which has more limited and traditional connotations—a room with rows of desks and a chalkboard, for example" (Stillar, 2012). They were also described as an environment that includes the activity and outcomes of learning, rather than being just a location where learning takes place (OECD, 2017). Defining the role of the physical setting on the educational process and utilizing it to enhance children's learning experience has become vital. "Physical features of learning spaces can stimulate emotions, create a sense of security, and prepare the students to learn" (Ariani & Mirdad, 2015). Since pedagogies are directly linked to space (Figure 27), one must study the design changes needed to turn 20th century schools into 21st century schools, providing children with settings that teach them to collaborate, communicate, think creatively and critically.

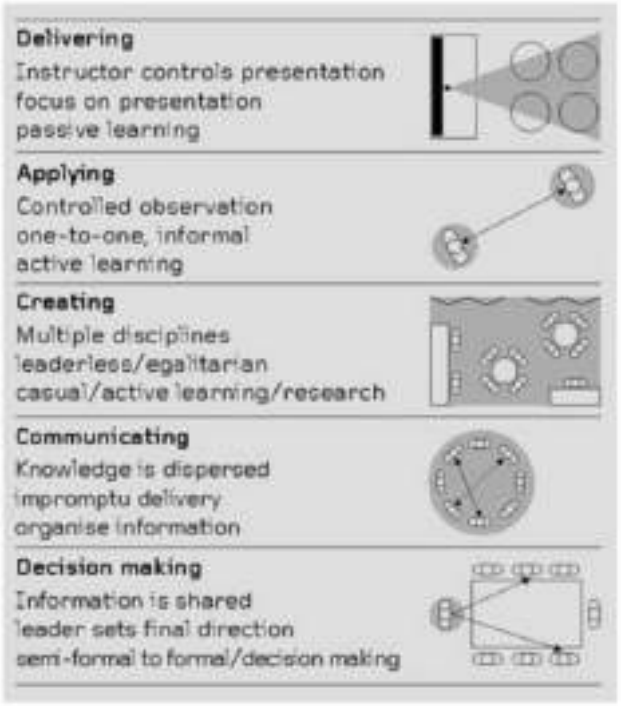


Figure 27: Linking Pedagogy and Space Diagram (Perez, 2017)

Despite its importance, educational infrastructure has been overlooked and given the least priority within the educational reform plans in Egypt. "While many reforms have been adopted to enhance the educational process in Egypt, most initiatives have instigated a quantitative expansion approach, rather than a qualitative one, which would focus on the quality of educational spaces" (Ibrahim, 2016). Since the physical setting of Egyptian schools encourages rote memorization up to this day, it is important to highlight the physical components that aid in this, and the changes that can be physically implemented to our school designs to promote 21st century learning skills.

4.2. Design Principles of 21st century Schools

To better understand what 21st century school buildings look like, the different design principles that are used to promote 21st century learning must be portrayed.

According to Sean O'Donnell, Principal Architect at Perkins Eastman, a twenty-first-century elementary school is a dynamic set of environments that must meet a broad range of educational, social, recreational, environmental, and community needs (IDB, 2012). He listed the main design principles as six aspects that must be considered:

1) Creating a child-scaled environment
2) Fostering flexible classrooms
3) Extending learning beyond the classroom
4) Employing subtle security
5) Engaging the community
6) Establishing a civic presence (IDB, 2012)

In 2011, Hanover Research reported on school design measures that contribute to developing 21st century skills, dividing them into four themes:

1) Flexible learning spaces
2) Sustainable design
3) Community engagement
4) Small schools (May, 2011)

OECD Programme on Educational Building and Department for Education and Skills defined seven themes for 21st century learning environments:

1) The challenge of designing schools in a changing world.
2) The impact of new technology on school design
3) Increasing access to education through school design
4) Designing sustainable, comfortable school buildings
5) Involving all stakeholders in school design
6) Educational facilities as a learning tool
7) Assuring design quality (Sigurðardóttir & Hjartarson, 2011)

Since most of the principles concluded by research are common, these points could be concluded into a single list including:

1) **Flexible and adaptable learning spaces**
2) **Extending learning beyond the classroom**
3) **Integration of technology**
4) **Environmental sustainability**
5) **Community engagement**

Spatially, each of these design principles could be applied in many ways. Yet through the study of the following cases, the exact meanings and methods of implementation could be portrayed.

4.3. Case Studies

1) Flexible and adaptable learning spaces

A recurring recommendation in the literature on modern school design is to incorporate flexibility into the design of learning spaces. **"**This demand for flexibility applies to many different features of a building, such as spaces and environments for different group sizes and learning styles, dynamic boundaries and the ability to change facilities according to pedagogical needs and ideas" (Sigurðardóttir & Hjartarson, 2011)**.** (Figure 28)

Figure 28: Flexible Classroom by P21 (May, 2011)

Flexibility is vital for two reasons: meeting the diverse and evolving student needs and being adaptable to serve its purpose far into an unpredictable future and serving the specific learning goals outlined in the Framework for 21st Century Learning.

a) St. Mary of the Cross Primary School, Australia – Baldasso Cortese Architects

The concept of flexible learning spaces was implemented in St. Mary of the Cross Primary School through the architect's vision of creating a 21st century school for children that acted as a "Community Hub". Holding 250 students, the school was designed to be a large learning environment interconnected with specialist spaces and outdoor learning areas (Figure 29). The "learning communities" were provided with multiple types of seating for different modes of instruction, where children could gather in groups, work individually, or engage with their teachers. The overall transparency between spaces connects learners and

Figure 29: St. Mary of the Cross Primary School Floor Plan (Archdaily, 2013)

creates a great sense of community. This setting also increases children's interaction and collaboration on different projects. Each learning space has direct access to the 5 shared activity spaces such as an Art Area, The Beehive, Drama…etc. (Figure 30) and has access to outdoor learning spaces. The school's physical setting embraces children's need to move and fosters inspiration and creativity through allowing children to observe and interact. (Archdaily, 2013)

Figure 30: Learning Communities and Activity Spaces (Archdaily, 2013)

b) Centerview Elementary School, U.S.A – Wold Architects and Engineers

The flexibility of learning spaces was also applied to Centerview Elementary School. By rethinking the concept of a classroom and designing the "Learning Studio" (Figure 31), the school aimed at breaking up the idea of a 1 to 25 ratio between teachers and students. The learning studio accomodates individual, small group, large group, and multiple-class sizes. Everything including furniture and operable walls, is multi- functional in the learning studios and make them flexible from top to bottom. (WoldAE, 2019)

Figure 31: Learning Studios (WoldAE, 2019)

Instead of designing a dedicated art room, "Flex Labs" were built (Figure 32), certainly having the facilities to work in art and music or science, but fundamentally adaptable to

different things teachers need to do. Furniture was chosen to be easily movable by children and sinks and cupboards were designed to surround the room to enhance its multiple usage without interrupting the space.

Figure 32: Flex Labs with movable furniture for multiple uses (WoldAE, 2019)

c) **Vittra Telefonplan, Sweden –** Rosan Bosch

Designed to be a school without walls or classrooms, Vittra Telefonplan (Figure 33) portrays the concept of flexibility and adaptability of spaces by giving students and teachers many different options, through furniture that allows them the ability to modify their postures as lessons allow.

Figure 33: Vittra Telefonplan Floor Plans (Bosch, 2012)

Instead of making containers for children, Bosch created magnets. The "show-off" (Figure 34) is a blue, stepped mountain that serves as a venue for teachers and students to present their work to an audience of their peers, as well as the entire school. "The cave" (Figure 35) serves the opposite purpose: it is a red, carpeted nook underneath the mountain where you can get away from it all and have a private moment or conversation. Concentration niches, which are often color-coded red, provide private workspace, while a child seeking interaction can go to "the watering hole," (Figure 36) which is the open public space, or to the village of tables for small-group work. "The campfire" (Figure 37) represents a space for tight group discussions and "the laboratory" (Figure 34) is a self-exploratory zone of metal-topped tables ready for hands-on science or cooking experiments on the working set of appliances. (Bosch, 2012)

Figure 34: The Show Off + The Laboratory (Bosch, 2012)

Figure 35: The Cave (Bosch, 2012)

Figure 36: The Watering Hole (Bosch, 2012)

Figure 37: The Campfire (Bosch, 2012)

2) Extending learning beyond the classroom

In 21st century schools, learning is not confined to the classroom. A school should provide opportunities for students to develop mentally, socially, and emotionally by appropriate design because formal and informal learning can and should occur within the campus. As a result, every square meter of campus should be viewed as a potential learning environment.

Circulation sometimes accounts for more than 25% of the space in some schools (IDB, 2012). Therefore, using this space for displays can engage students' imaginations as they walk around the school. Seating areas can provide a place to sit with a friends and interactions with teachers can reinforce classroom activity. Circulation space may also be reimagined as an active extension of the classroom, allowing for small group work, reading sessions, and projects. Transparency between the space adjacent to the classroom and the classroom encourages active use of circulation space by allowing faculty to observe and participate. The concept of optimising the campus applies to the outside as well, where courtyards could be used for learning in hot climates as well as gardens, amphitheatres, and plazas.

a) Concord Elementary School, U.S.A – HMFH Architects

At Concord Elementary School, the design probed the very nature of 21st century learning, embodying the philosophies of independence, collaboration, and creativity. The design process focused on three ideas: spaces should support collaborative learning; these spaces should be easily accessible by staff and students to fully integrate them into the day-to-day learning experience; and spaces should house a range of flexible environments to support a range of learning activities (Figure 38) (Vinnitskaya, 2012).
Built with the budget of a 'traditional' school, the innovative program of the school featured multi-use Learning Corridors (Figure 39) – shared spaces that weave through each school outside classroom doors.

These spaces integrate project-based learning into the daily curriculum with discrete spaces for media presentation, performance, quiet individual learning, and small group projects. As the heart of the school, the learning corridors promote collaboration between students and educators, maximize technologies, and create opportunities for interdisciplinary and inter-grade learning.

Figure 38: Concord Schools First Floor Plan - Learning Corridor (Vinnitskaya, 2012)

Figure 39: Learning Corridor Spaces (HMFH, 2012)

b) **Discovery Elementary School, U.S.A –** VMDO Architects

Discovery Elementary School (Figure 40) was designed to inspire students and teachers to use the building creatively to facilitate everyday learning and lifelong exploration. The "Discovery Explorers" name reflects the forward-looking, inquiry-based learning that takes place in the building (VMDO, 2015).

Wayfinding at the school goes beyond simple navigation to promote a broader vision of spatial organization that represents each grade's evolving curriculum and identity. (Figure 41) The first floor of the school is themed around animals found in earth eco-systems, and the second floor is themed around the elements of the sky and heavens. As students move through the school, their "world expands" – This storyline is depicted graphically on an entry wall, with each Explorer grade level highlighted.

Explorers will "make their mark" on their expanding world by signing their name on the wall on the first day of school. Spaces such as the "learning commons" also integrate with circulation to create a variety of zones where learning can happen anywhere.

Figure 40: Discovery Elementary Learning Spaces (VMDO, 2015)

Figure 41: Pedagogical corridors and learning commons (VMDO, 2015)

3) Integration of Technology

Due to the technological advances of the 21st century, children have grown up using technology since they were toddlers. Consequently 21st century learners have long used technology before school, for both entertainment and learning. It is therefore very important to integrate technology into education, allowing for students' full engagement and to enhance the skills that they need, preparing them for their future academic and professional experiences.

The introduction of technology into the classroom will help students take a more active role in their learning as teachers guide them, transforming the classroom experience from a traditional teacher-centred one to a student-centred one. Technology also provides teachers and students with access to a variety of educational resources that inspire creativity, critical thinking, communication, and collaboration. It promotes inclusion and the development of digital literacy skills in addition to extending learning beyond the text, and beyond the classroom walls (KnowingTech, 2015).

The use of technology in education also exposes students and teachers to new online global communities. As a result, global consciousness, an important component of a 21st-century education, is promoted. Differentiated teaching can be made even simpler using

instructional technology, addressing the different levels of students and different learning needs within a classroom.

a) Eminence Independent Schools, U.S.A – Studio Kremer Architects

Eminence was doing 21st century education in a 19th century building. It was vital that they created a facility that matched their philosophy. Therefore, with the financial support of the community, Studio Kremer designed the EDhub (Figure 42). "The EDhub stands for the Experimental Davinci Hybrid Ultra Bibliotheca, so it's kind of a fancy newfangled library." (Edutopia, 2017)

EDhub depends on STEAM, which is an instructional approach to education that emphasizes Science, Technology, Engineering, the Arts, and Mathematics as entry points for guiding student problem solving and critical thinking. It equips the learners and leaders of tomorrow through experiential learning which incorporates advanced science, emerging technologies, applied engineering skills, and artistic design. "The goal is to empower students to be risk-takers, collaborators, communicators, leaders, and visionaries."

Figure 42: The EDhub at Eminence Independent Schools (Krauth, 2019)

EDhub consists of a core open space (Figure 43) with large windows providing students the ability to see in all areas at the same time, giving them a sense of community. It contains eight maker labs ranging from robotics to bio, to a TV studio, traditional power tool and design thinking lab.

Figure 43: The EDhub core open space (Bendici, 2019)

Students can not only check out books but can also check out tools, and use laser cutters (Figure 44), to create things they drew in their notebooks. The space was designed to be 100% functional, holding lots

Figure 44: Students using a laser cutter (EIS, 2017)

Figure 45: Magnetic Walls (EIS, 2017)

of movable magnetic walls (Figure 45) and writable surfaces. The integration of technology in this space is transforming learning because of the collaboration skills that they learn. “They are building, creating, designing, constructing. All the skills that you would use in the workplace” (Edutopia, 2017).

b) Centerview Elementary School, U.S.A – Wold Architects and Engineers

At Centerview, the same concept was applied. A central space holding what was previously known as the library or the media center was designed to become the “Learning Commons” (Figure 46). “It’s a place where staff members, students and community members can collaborate, where they can have deep conversations about learning and teaching and about what’s important to them” (NorthMetroTV, 2018). The space was designed for multiple purposes, serving the school’s concept of flexible learning environments. It holds learning stairs where people can sit and talk individually, collaboratively, as a whole group. The space also contains a stage that students can use for musical performances or an art gallery, where they are also able to present and share their learning with one another. Since the learning commons merges both the library and media centre, it contains a repository for books as well as a large screen set over the stage for digital reading that can be accessed through iPads.

Figure 46: The Learning Commons (WoldAE, 2019)

4) Environmental Sustainability

Although several schools are looking at environmentally friendly design strategies to cut operational costs and carbon footprints, research indicates that districts should also consider how sustainable design affects student achievement. According to P21, lighting

and air quality have proven positive effect on learning, and temperature was added to the list of environmental factors that impact learning outcomes. “Studies have found that student learning rates have improved between 7 and 26 percent in classrooms that are exposed to adequate day lighting” (May, 2011)**.** In an article published by the National Clearinghouse for Educational Facilities, studies found that student achievement declined when temperatures fell outside of a comfort zone, which is between 20 and 25 degrees Celsius (May, 2011). As a result, designing schools around environmental sustainability standards could result in long-term cost savings (on lighting, cooling, and ventilation), as well as increased student achievement. The saved money could instead be used for more beneficial services or facilities for students and staff.

Some schools are also constructing outdoor classrooms and meeting places to increase student exposure to natural elements, which has been shown to improve achievement. Greenery is replacing much of the pavement, including new garden beds and trees. Other features include play structures, painted graphics, outdoor furniture, and public art. Some schools also developed specific curriculums around the outdoor classrooms such as "Science in the Schoolyard" and "Outdoor Writers Workshop." (Figure 47)

Figure 47: Human Bar Graph (Broda, 2016)

P21 identified environmental literacy as a 21st century interdisciplinary theme students will need to master. As they illustrate the practical implementation of environmental values, "green" schools offer the ideal setting for students to improve their understanding of environmental concepts.

a) **Discovery Elementary School, U.S.A –** VMDO Architects

Discovery is an all-electric building that generates clean, renewable solar energy to completely offset its energy consumption. In the iterative design process, site footprint, solar orientation, building construction, and energy usage were given top priority. “With a capacity of 650 students, the building is designed for an Energy Use Index (EUI) of 23kBTY/sf/year, one third of the energy use of a typical elementary school” (VMDO, 2015).

Figure 48: Discovery's Solar Panels (VMDO, 2015)

Figure 49: Discovery's Sustainable Features (VMDO, 2015)

The school has been a leader in the field of zero-energy schools, both in terms of demonstrating success and involving students in the "building as a teaching tool" concept (VMDO, 2015). It has 1,706 roof-mounted solar panels (Figure 48) covering the whole length of the building, as well as a geothermal well field. It depends on 100% LED lighting, and is constructed from insulated concrete exterior walls with high thermal mass. The building's solar orientation and shading are ideal to the site. Overall, Discovery carries eight different sustainable features that make it an excellent example of a sustainable 21st century school. (Figure 49)

b) TVT Community Day School, U.S.A – LPA Design Studios

Figure 50: TVT Community Day School Floor Plan (LPA, 2017)

This progressive, sustainable school believes that "joyful learning today leads to meaningful achievements tomorrow" (LPA, 2017). It promotes student-centric learning with indoor and outdoor learning spaces. Originally established in 1991, TVT expanded recently adding the new MAKER + science, STEAM and Fitness buildings (Figure 50), reimagining the campus exterior so it is in-line with today's 21st century educational needs, providing the ability for learning to happen anywhere. "The newly re-imagined campus exterior is a place that inspires, allows for reflection, and provides opportunities for exploration" (LPA, 2017).

The lower campus's functionality was extended to the outdoors, giving children access to a new amphitheatre, growing grounds and a farm, writable surfaces, outdoor art courtyard, interactive water play creek, and other facilities that promote health and learning. The Huddle, a room in the MAKER building, expands on the flexible classroom concept by extending learning space outside (Systems, 2019). Child-size huts were designed for reading nooks. (Figure 51) Traditional playground features such as

basketball half-courts, four square courts and ball walls were also included, providing plenty of options to stay active and enjoy the outdoors.

Figure 51: Outdoor learning areas at TVT (LPA, 2017)

Environmentally, stormwater was planned to be collected and treated on site. Water is managed and directed into infiltration basins that are integrated into the surrounding landscape by the landscape design. A 37m^2 green roof provides colour, texture, and visual interest to the campus (LPA, 2017). (Figure 52) Different methods of ventilation, lighting and temperature control were also utilized throughout the building to provide sustainability and wellness. (Figure 53)

Figure 52: TVT green roof (LPA, 2017)

Figure 53: Sustainability and Wellness at TVT (LPA, 2017)

5) Community engagement

Recently, experts have agreed that community engagement in the school design process is fundamental to building schools that support 21st century learning (Figure 54) (May, 2011). Schools are an important aspect of any community, and their presence and success affect everyone in it, including individuals who have no direct links to the school. Community members bring varying opinions and perspectives, which can contribute positively to school design. Their resources are also key to the school's survival, thus long-term assistance is essential. Furthermore, incorporating

Figure 54: Community meeting for school design (Baltimore, n.d.)

multiple stakeholder groups aids in the corroboration and cross-checking of expert knowledge, as well as giving design proposals a better sense of legitimacy (May, 2011).

A group of teachers and students, educational researchers and administrators, community leaders, parents, technicians, and architects should all be included in the design process. Their task is to collaborate to establish aspirations and local needs, as well as to sketch out a rough concept for the new structure. An example of an aspect they could work on together is decide upon or identify key messages the building should send to students, staff, and the wider community (Sigurðardóttir & Hjartarson, 2011) .

According to a study done by the British non-profit organization, School Works, that investigated student perceptions about their schools, young people had a clear grasp of the linkages between their school environment and learning (May, 2011). Students provided feedback on many parts of their school's physical space, such as dining spaces, classrooms, and meeting facilities. P21 stated that students find that getting involved in building design gives them with a valuable real-world learning experience (May, 2011). Participation may help to acquire key 21st-century abilities. Building design necessitates both creative and critical thinking, as well as artistic abilities. Furthermore, participating in a collaborative process allows children to practice leadership, judgement, and cooperation. Therefore, it is very important that the design process takes place with integration of multiple stakeholder groups to achieve the maximum satisfaction of needs.

a) **Ballifield Primary School, UK –** Prue Chiles Architects

In 2000, Sheffield's Department for Education and Skills (DfES) launched a program called "Classrooms for the Future" aiming to rebuild, refurbish or upgrade primary schools and offer 21st century learning environments. (Designing with Children, 2013) In this context, Ballifield Community Primary School project was established, exploring what a 21st century classroom should be like. The project enlisted designing and building two new classrooms (Figure 55) at an affordable cost and investigating more generic, possibly prototypical, solutions with regards to the school environment (Chiles, 2003).

Figure 55: Two New Classrooms at Ballifield Primary School (CE+CA Studio, 2003)

The project was conducted in collaborative partnerships between the Bureau of Design Research, The University of Sheffield, the Local Education Authority, teachers, and students (age 5-10 years old). As part of the project, Architecture students from Years 4 and 5 of the University of Sheffield worked with the children to address parts of the existing school and its grounds, looking at both interior spaces, as well as the school grounds (Designing with Children, 2013).

The project lasted for six weeks, involving an introductory session through use of cartoon strips to introduce the job of the architect and flash cards showing images. (Designing with Children, 2013) Using slides, the students and the children then looked in more detail the built environment and inspirational school buildings. These workshops unfolded through four sessions, and the children modelled an ideal classroom, surveyed favourite places and places to avoid and answered questions. They were encouraged to draw and keep notes and engaged in several different activities to prompt their expression. (Figure 56)

Figure 56: Children modelling (Designing with Children, 2013)

/The outputs and outcomes of the project were: building of two classrooms replacing run-down mobile units (Figure 57,58), and the refurbishment of some other indoor and outdoor spaces.

Figure 57: Architects' proposal of classrooms after the workshops with children (CE+CA Studio, 2003)

Figure 58: Final product of Project - Two Classrooms constructed by CE+CA Studio (CE+CA Studio, 2003)

Conclusion

As observed in the above case studies, the five design principles that define 21st century schools can be applied in numerous ways. In turn, characteristics such as flexibility and learning outside the classroom provide a medium for collaboration, communication, critical and creative thinking, as well as some life skills showing their characters including leadership, flexibility, initiative, and others. Integration of technology aims at enhancing the IMT skills, as well as reinforcing life skills such as initiative and critical thinking. The concept of sustainability and using the building as a learning tool promotes environmental literacy. Community engagement stresses on the fact that a design process must be participatory to really cover its users' needs, eliciting the sense of belonging of children and enhancing their critical and creative skills, as well as allowing them to participate in what is a sample of the real world they will face as adults. Therefore, if the target is to design 21st century school buildings, or redesign existing traditional buildings to fit 21st education, these five principles must be implemented to provide spaces that promote 21st century skills.

III. Empirical Study

Methodology

The first part of the research, which included reviewing international and local literature, understanding the evolution of school architecture, 21st century learning, and its reflection on current school building design, led to the empirical part of the research. With the aim of studying the existing school architecture within the local context, emerged important questions that reflect upon the literature review. The first question reflects on the different prototypes of existing governmental school buildings in Egypt. As the literature portrayed, both global and local school architecture was designed for the purpose of mass education, mainly known as the "Factory Model". (Toffler, 1984) Although many movements tried to veer away from this model, focusing on more student-centred approaches, Factory Model schools continued deep into the 21st century, offering standardization, minimal expenses and schools that served quantity rather than quality. Therefore, the research will investigate primary school design in the Egyptian context, highlighting prototypes, spatial characteristics, and qualities of these buildings.

The Framework for 21st Century Learning introduced by Partnership for 21st Century Learning (P21), which has been adopted internationally, also poses new questions within the local context. As it was reflected in the literature review, 21st century learning is shifting from the previous industrial factory-based mindset to a knowledge-based mindset to suit the current economy. (SEG, n.d.) The 21st century requires people who are flexible and capable of adapting to rapid change. Therefore, they must have the skills necessary to deal with the fast pace of information of the digital era. These skills include creativity, critical thinking, collaboration, and communication (the 4Cs), as well as digital literacy and the personal skills required for life such as flexibility, leadership, initiative, productivity, and social skills. (P21, 2019) Is this applied to education in Egypt? Are children, parents, and teachers aware of these needs? Can this framework be applied through the physical setting of a school? All such questions will be answered throughout the empirical field work.

Throughout the last part of the literature review, the differences between 20th and 21st century school buildings were portrayed. While 20th century schools depended on achieving compliance and conformity (Schwartz, 2016), 21st century

schools are being designs according the 21st century learning skills. The reflections of 21st century learning skills on school architecture were then reviewed through literature and international case studies, consequently leading to the five design principles of 21st century schools. This posed questions within the local context such as: Are these principles available in our school buildings? What principles do the designers follow? How do children feel about the current school buildings? Are these principles needed to achieve better quality of education? Do the current school buildings have potential to adopt these principles? The fieldwork aims at answering these questions to report on the existing cases and deduce recommendations for 21st century school buildings in Egypt.

The empirical fieldwork was conducted through four different phases. Firstly, a study of the existing school infrastructure and prototypes was done through gaining information from the designers and construction managers at the General Authority for Educational Buildings (GAEB).[4]

Secondly, physical, and spatial analysis of schools was conducted through the inspection of a random selection of schools in three different districts in Cairo. Overall, eleven school buildings were visited between the dates of the 20th of May 2021 to the 1st of June 2021. Five of these schools were in East Nasr City, two in Maadi, and four in El Basateen and Dar El Salam. The districts were selected to cover the varying social standards present in Cairo, as well as the different urban contexts. Another six schools were studied through the review of their architecture drawings, three in Al Waily district, two in Manshiet Nasser and one more in Maadi. Yet these schools were not visited since no additional insights seemed to be collected after the visitation of the eleventh school, therefore the sample size reached saturation after the eleventh sample.

Due to the limitations of COVID-19 pandemic, and the abrupt decision passed by the Ministry of Education on the 25th of April 2021, to end the school year on the 30th of April 2021, (Youm7, 2021) the schools visited were not operating. Therefore, no students or teachers could be interviewed or observed within school premises, and only a spatial inspection of the building was conducted.

[4] GAEB: The General Authority for Educational Buildings in Egypt. The agency responsible for the construction of educational facilities in Egypt. Will further be introduced in detail throughout the empirical study.

Consequently, two online questionnaires were prepared to gather school user insights, the first targeting primary school children enrolled in governmental schools, with the help of their parents, and the second targeting teachers. Finally, two workshops were conducted with a total of 45 children, the first in Ezbet El Nakhl district and the second in Imbaba. They aimed at understanding children's reflections of their schools and reflecting on their needs. They also aimed at exploring the children's awareness of the 21st century skills and testing their abilities to participate in the co-design of a classroom space accordingly.

The identity of all participants, whether architects, children, parents, or teachers is to remain confidential to ensure trust between participants and the researcher. Names of the schools will also be dealt with in anonymity since education in Egypt was declared a matter of national security by the Egyptian government in 1990 (Hegazy, 2012). They will be referred to using initials and numbers where schools located in Easter Nasr City will be referred to as ENC1 to ENC5. Schools located in Maadi will be referred to as M1 to M3 and those located in El Basateen and Dar El Salam will be referred to as BD1 to BD4. Schools located in El Waily will be referred to as W1 to W3, and those of Manshiet Nasser as MN1 and MN2. A complete list of the schools, their codes, areas, types, educational stages, and date of visitation are presented in Appendix A.

Egyptian Governmental Schools – Field Research

5.1. Background

To begin fieldwork, it was essential to understand the system of educational facilities in Egypt, who is responsible for their design and construction, and what prototypes exist. "As per ministerial decree no. 448 of 1988, the General Authority for Educational Buildings (GAEB), affiliated with the Ministry of Education, has responsibility for organizing the process of designing, building, and furnishing public schools" (Sobhy, 2019). It oversees constructing, selling, and replacing structures and land that are required to achieve those goals.

The GAEB's responsibilities include developing and implementing a plan that should start with a needs-assessment study at the administrative division level to determine the needs of each governorate and to highlight the necessary budget for implementation within a specific timeline. It is also expected to develop standards, specifications, and designs for educational buildings, taking into account the differences between urban and rural areas, new pedagogical strategies, and the needs of each educational stage. The GAEB operates as the technical authority responsible for the maintenance and refurbishment of existing school buildings in conjunction with the decentralization units in the directorates of education (Sobhy, 2019).

Overall, there are four design models for school buildings in Egypt; the "Typical Model" (*al-namuthaj al-namaty*) which is used all over the country. Then there is the "Technical Education Model" (*al namuthaj al-fanni*), which uses the Typical Model school, but also includes technical workshops. The third is called the "Access Model" (*namuthaj al-itaha*), which is used in small villages with small densities. Finally, there are the "Unique Models" (*al-namathej al farida*) which vary based on the nature of the school, such as

the STEM schools, Talented schools, and the Japanese schools (Sobhy, 2019). These models are all designed, implemented, and maintained by the GAEB. The focus of this research and the fieldwork will be on the Typical Model since it is the most predominant model.

According to the ministerial decree no. 306 of 1993, all governmental schools must follow the site selection criteria and school building standards set by the GAEB to gain permits for construction (GAEB, 2011). The authority designed several prototypes for all the education stages including primary schools. The number of classrooms in each prototype of these Typical Models varies from eleven classes to 55 classes per school (GAEB, 2011). According to the GAEB's guidelines, a specific building program was set for each of these prototypes (detailed in Appendix B). Other guidelines included minimum school areas, student's share of the different areas in the school, maximum number of students per class, the dimensions of the school building, and several others. Listed in Table 2 are some of the standards related to primary schools in established cities and villages.

Criteria	Basic Education	Mixed Education (Basic + Secondary)
Minimum school area	1,200m^2	2,500m^2
Student's share of the total area of the school	4m^2	5m^2
Student's share in playgrounds and open areas	2.5m^2	2.75m^2
Maximum number of students per class in public schools	40 students/class	36 - 40 students/class
Minimum number of students per class in public schools	25 students/class	25 students/class
Classroom area	A minimum of 38m^2 with a maximum length of 8.5m	
Student's share in class area	1m^2	1m^2
Minimum width of single loaded corridor	2.4m	2.4m
Minimum width of double loaded corridor	3m	3m

Table 2: Spatial standards of governmental public schools (GAEB, 2011)

Upon visiting the GAEB to collect more data on the types of schools that currently exist in Egypt, it was found that not only are there two types of governmental schools; Arabic and Experimental, but there are also different categories under the Experimental school, namely Distinctive, Future, and International Public schools. These categories were included in the field work.

While all public schools fall under the category of free education, minor fees are paid for the enrollment of children in schools. Fees differ from one category to another, where Arabic school fees range from 70 to 100EGP conducting all education in Arabic. Experimental school fees range between 600 to 700EGP. Distinctive schools, which are the first category of higher Experimental schooling, have fees ranging between 2000 to 2500EGP. Future schools have the same range. Lastly, the International Public schools, which are governmental schools operated by the private sector, teaching international curricula, range between 17,000 to 20,000EGP (GAEB, 2021).

When questioned about the differences between the categories' school buildings, the answers pointed to minor differences such as less children per classroom (36 instead of 40 students/class for example), some finishing materials, and the category of furniture. Yet the same school standards and facilities are mostly applied to all types (GAEB, 2021).

5.2. Case Studies – Category 1: Arabic Schools

The first and most common category of governmental school buildings inspected was the Arabic school. Seven schools were analysed under this category, four of which were visited while the others were reviewed through the study of the architecture drawings (Appendix C).

5.2.1.M1

The first school was in Maadi (M1) and was visited on May 27th, 2021. The site area was 2,022m^2 and the school was only for the primary stage. (Figure 59) It consisted of an old building holding 16 classrooms excluding labs, but due to the shortage in number, a new building was recently added as an extension in the school yard holding ten new classrooms, two in each of the five floors and flanked by two staircases. (Figure 60)

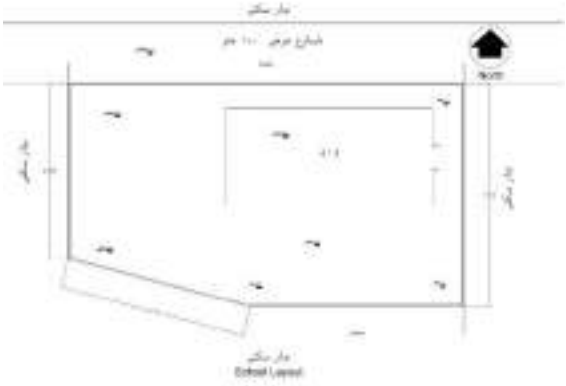


Figure 59: M1 School Layout (GAEB, 2021)

Figure 60: M1 Extension Building

The architecture of the old building was based on a 4m structural module and its multiples. Overall, it consisted of five floors. The ground floor held two Kindergarten classrooms, collective bathrooms, a lab, and an arcaded seating accessible from the school yard. The upper floors consisted of a central corridor and two staircases at each end. The classrooms each took up two modules, making their standard length 8m. They overlooked the northern elevation. On the southern façade were the administrative offices, labs, the library (12m long), and the fields (12m long) and the art classroom, which is now used as a standard classroom. No bathrooms were located on the upper floors. (Figure 61)

Figure 61: M1 Floor Plans (GAEB, 2021)

The classroom was lined with three rows of desks with attached benches, each row consisting of six to eight desks, supposedly to hold two students. Therefore, the average classroom capacity is about 36 – 48 students. It was noted in this specific school that the state of the building was deteriorated, and in some classrooms the furniture was mis-matched, containing some desks higher than others and some broken desks. Children's writing covered the classroom walls, and some posters were hung spontaneously. All classrooms held white boards covering old existing black boards. (Figure 62)

Figure 62: M1 Typical Classroom

The school corridors held no furniture, yet some posters, school rules and announcements were hung on the wall. A white board was located at one end of the corridor, titled "Semester achievements". Classroom doors were standard wooden doors, while library and lab doors and windows were secured with iron. (Figure 63)

The school yard was divided into two parts, where north of the building was a gated Kindergarten area supplied with playground equipment and artificial grass, while the rest of the school yard was tiled. The southern area held one sports field for both football and basketball, and benches lined the perimeter. Since the school is in Maadi, old trees exist in the neighbouring sites, providing shade to the school yard, and because it is narrow, the building also shades it. (Figure 64) The southern elevation overlooking the school yard contained vertical sun breakers to provide shading for the interior spaces set in the south. (Figure 65)

Figure 63: M1 School Corridor with iron bars on windows and doors

Figure 64: M1 School Yard

Figure 65: M1 Southern Elevation

5.2.2.BD1

The second Arabic school was in El Basateen and Dar El Salam district (BD1) and was visited on June 1st, 2021. Constructed over a part of an agricultural land, this school provides basic education and works for three periods a day, each for three hours. The site area was 6,460m^2 holding two buildings, one for the primary stage and the other for preparatory stage. (Figure 66) Further extensions were added to the site to provide classrooms for the increasing numbers. A second building was built as an extension to the primary stage east to the existing buildings. It consists of five floors with two classes each and one staircase at the end, adding ten classrooms to the school.

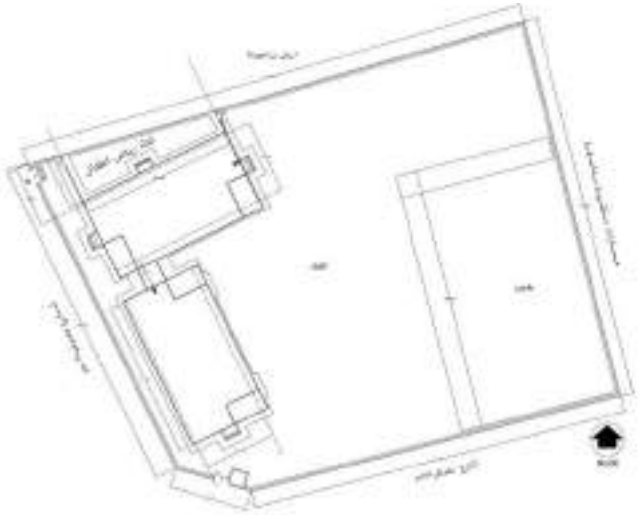


Figure 66: BD1 School Layout (GAEB, 2021)

The architecture of both buildings was the same modular prototype observed before. They consisted of five floors with a central, double loaded corridor and a staircase at each end. The primary school building (aligned to the agricultural land) included 18 classrooms excluding labs and Kindergarten classrooms, which took six classrooms on both the ground and first floors. Bathrooms were again located on the ground floor only, and the computer lab, administrative offices and teacher rooms were all on the southern façade. (Figure 67)

The classrooms were aligned with four rows, each including 6 desks which would supposedly hold two students, making the classroom capacity about 48 to 50 students. All classroom windows were barred with steel bars or a steel mesh. The classrooms each contained two ceiling fans and had the Egyptian flag painted on the back wall. (Figure 68) They align both northern and southern facades in the upper floors. The corridor and staircases are lined with steel meshing to ensure the security of students. (Figure 69)

Surrounding the buildings was a tiled part of the school yard while the rest of it was sand. An extension building is currently being erected in part of the school yard. (Figure 70)

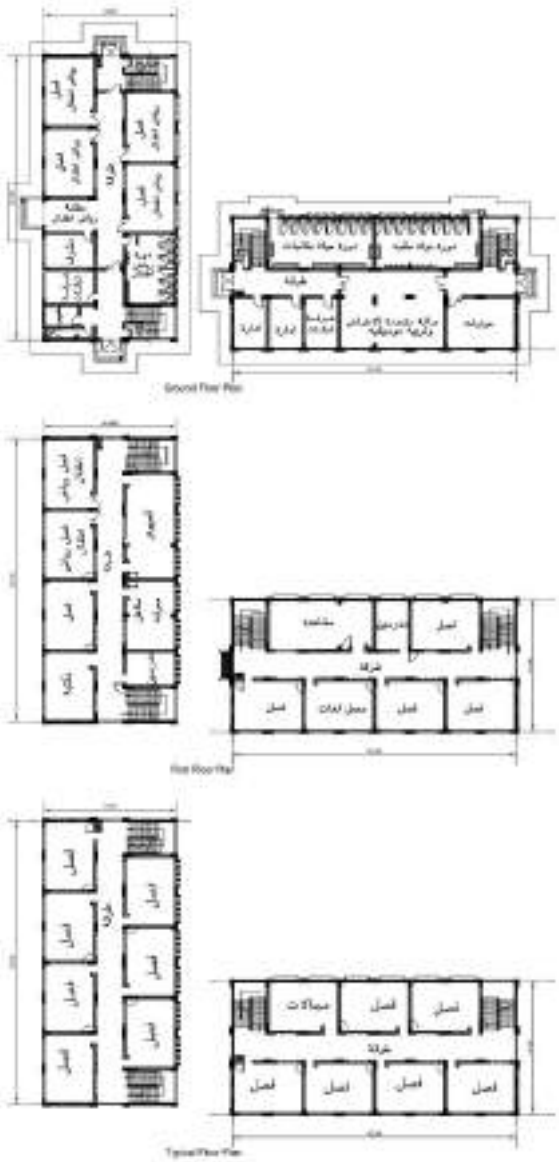


Figure 67: BD1 Floor Plans (GAEB, 2021)

Figure 68: BD1 Typical Classroom (Interior and Exterior)

Figure 69: BD1 Corridor and Staircase

Figure 70: BD1 School Yard with new extension building and surrounding buildings.

5.3. Case Studies – Category 2: Experimental Schools

The second category of governmental school buildings inspected was the Experimental school. Four schools were analysed under this category, two of which were visited while the others were reviewed through the study of the architecture drawings (Appendix D).

5.3.1. ENC2

The first Experimental school inspected was in East Nasr City (ENC2) on May 20th, 2021. A large school complex, it was of area 5,520m^2 consisting of four buildings: the old building with the main classrooms, the new building which was added as an extension, and two small buildings incorporating toilets for both genders overlooking the school yard. (Figure 71) The complex served basic education, with a total of 42 classrooms excluding labs.

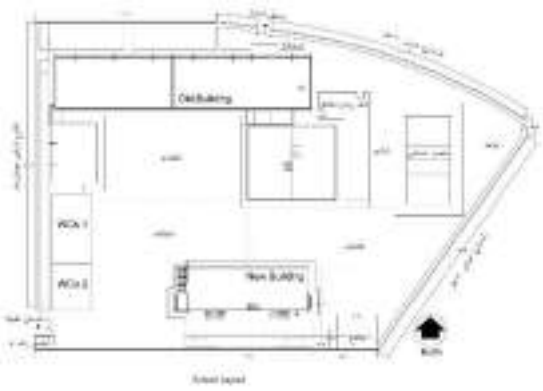


Figure 71: ENC2 School Layout (GAEB, 2021)

The old building (Figure 72) was composed of three attached parts: the east building (two floors) holding Kindergarten, the library, a theatre, and some administrative offices. The middle section (five floors) held classrooms and labs, while the west building (two floors) held labs and Fields classrooms. There was a noticeable difference between this school's spatial program and that of the Arabic school since it provided many facilities that were missing in the other schools visited before. The old building featured a single loaded corridor overlooking the school yard with classrooms oriented towards the north façade. This provided better natural light and ventilation throughout the building.

Figure 72: ENC2 Old Building Floor Plans (GAEB, 2021)

The classrooms did not differ much from those observed before, holding the same three rows of desks with an overall capacity ranging between 38 to 42 students per class. Some of the classrooms were more deteriorated than others, yet most classes had smart boards and projectors installed. (Figure 73) The labs were well furnished and seemed to be used, although this is to be confirmed through the questionnaires. (Figure 74) The corridors contained a few benches with desks for students to use and had some posters on the walls. (Figure 75)

The new building (Figure 76) held 19 classrooms and overlooking a central, double loaded corridor and some extra facilities. Classes were furnished with standard new desks and smartboards. It was observed that one classroom had been turned into a server room supplying the new building with internet access. Connections were made from the server room to every classroom. (Figure 77)

The school yard contained four different zones, two of which were tiled used for football and basketball, a sand yard, and an area for the kindergarten playground. Some trees lined the courtyard perimeter with a few benches under them for student seating, and a mosque was also found on the premises.

Figure 73: ENC2 Old Building Classroom

Figure 74: ENC2 Labs

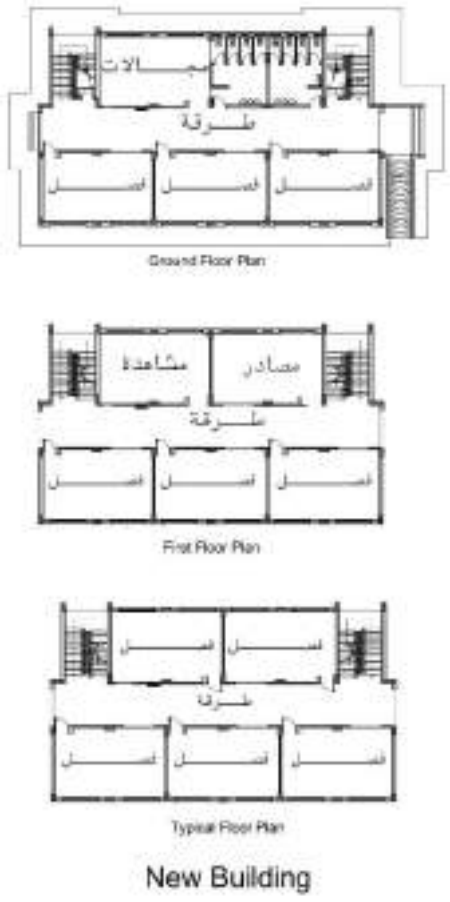


Figure 76: ENC2 New Building Floor Plans (GAEB, 2021)

Figure 75: ENC2 Corridor

Figure 77: ENC2 New Building Classroom

5.4. Case Studies – Category 3: Distinctive Schools

The third category of governmental school buildings inspected were the Distinctive schools. Two schools were analysed under this category, both located in East Nasr City and visited on May 20th, 2021. (Appendix E)

5.4.1. ENC3

The first Distinctive school consisted of a site area of 8,731m^2 with a large building holding all learning spaces serving education from Kindergarten to Secondary school stages. (Figure 78)

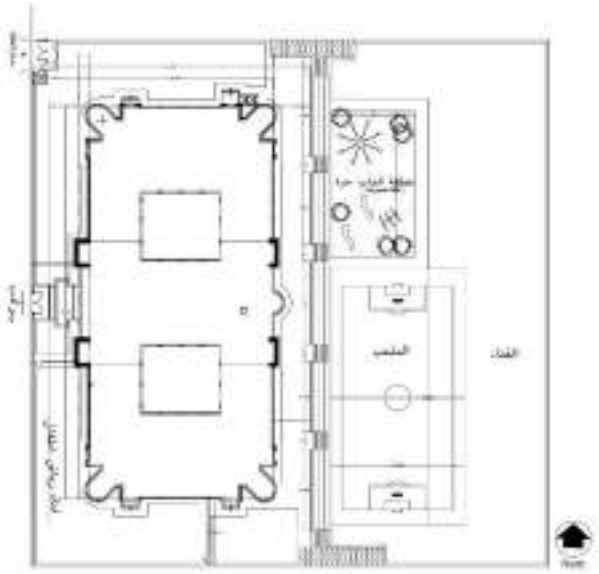


Figure 78: ENC3 School Layout (GAEB, 2021)

This building prototype was unique from the others visited before it, incorporating two central open courts and four rounded staircases located at the corners of the building, as well as two staircases in the central part. It holds a total of 42 classrooms excluding labs.

The ground floor held the library, computer lab, a multi-purpose hall, a cafeteria, and an agriculture class in the central unit between the courts, while classes lined the northern part of the building, and Kindergarten took the southern part along with the administrative offices. Bathrooms were set overlooking the open courts, surrounded by the corridors.

The upper floors mainly held classrooms, labs and some administrative offices lining the four elevations and the courtyards, yet on the second floor, an auditorium was found in the central part of the building on the east side. It was observed that in this prototype, bathrooms were found on the upper floors. (Figure 79)

Classrooms were the standard 38m^2 lined with the typical three rows of seven desks, making the average capacity per class about 42 students. They all had curtains installed and were both naturally and artificially lit. The back wall of most classrooms held bulletin boards while the front held white boards and notice boards. Posters lined some of the classrooms as well. (Figure 80) It was observed that one of the classrooms had the desks arranged facing each other, creating group tables for four students (Figure 81), and that the classrooms differ from each other in colours. The Science lab was also furnished in a group table setting, although the capacity was too large for the room limiting movement. (Figure 82)

No furniture was observed in the corridors which surrounded the internal courts, and the outdoor spaces were mainly a two levelled large sandy school yard, and a tiled sports field used for both football and basketball. Between the two levels of the school yard, stepped seating was found. (Figure 83)

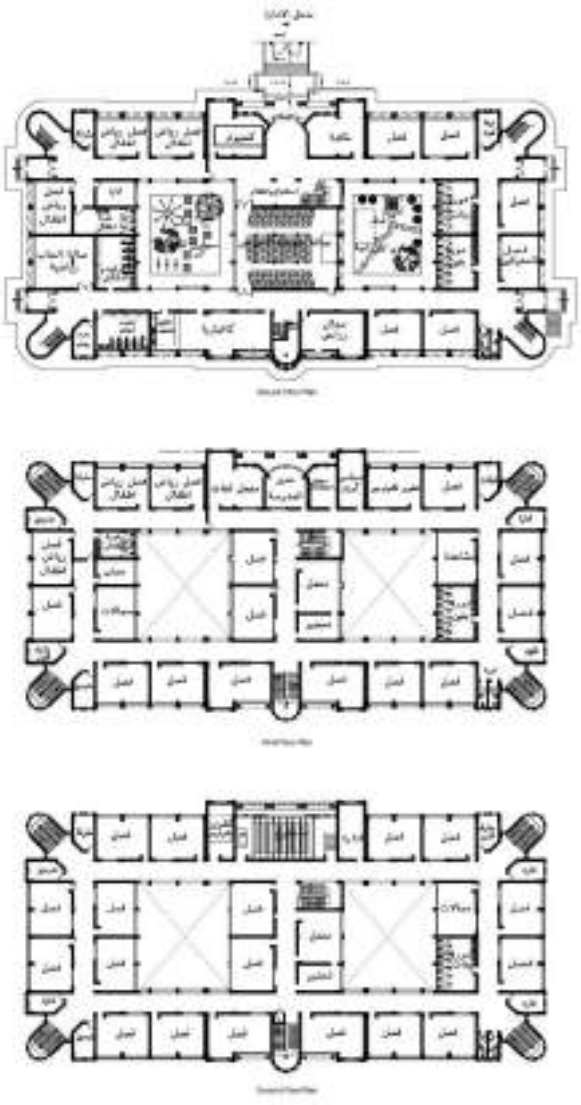


Figure 79: ENC3 Floor Plans (GAEB, 2021)

Figure 80: ENC3 Classroom

Figure 81: ENC3 Group setting in a classroom

Figure 82: ENC3 Science Lab

Figure 83: ENC3 Outdoor spaces (Internal courtyard + School yard)

5.5. Case Studies – Category 4: Future Schools

The fourth category of governmental school buildings inspected was the Future school. Three schools were analysed, two of which were visited while one was reviewed through studying the architecture drawings (Appendix F).

5.5.1.BD4

The first Future school was located in El Basateen and Dar El Salam district and was visited on June 1st, 2021. Consisting of two adjoined sites, the original school site was extended because the numbers exceeded the building capacity. Therefore, the site covered a total of 6,057m2 with a total of 56 classrooms. (Figure 84)

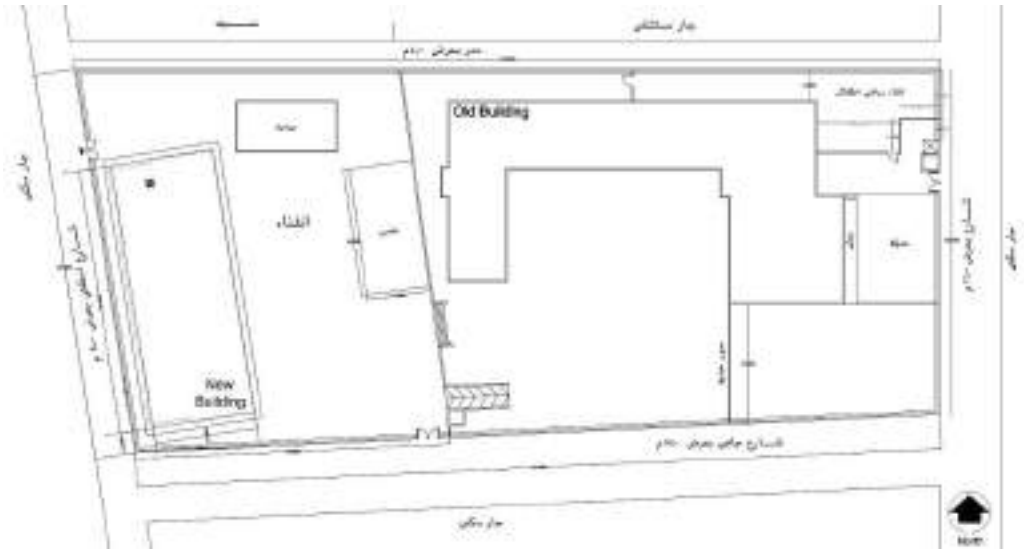


Figure 84: BD4 School Layout (GAEB, 2021)

The old building was the same U-shaped prototype of ENC2, with a single loaded corridor serving the classrooms, the central part of the building consisting of five floors, the east part of the building holding Kindergarten, the principal's office, a library, and a computer lab (two floors only), and the west part of the building holding labs, the agricultural field classroom, and quality control (three floors). The whole building was divided according to a 4m module and its multiples. (Figure 85)

The classrooms were again the standard 40m2 holding a capacity of 30 to 36 students in average. The desks were lined in three rows, paired seating. Only white boards were installed, and the state of the furniture was deteriorated. (Figure 86) The library and computer lab were well supplied with books and computers and are frequently used. (Figure 87,88) A sign hung on the wall in the corridor indicated the school's vision for community engagement, and a box for complaints that is opened weekly by a school committee. (Figure 89)

Figure 85: BD4 Old building Floor Plans (GAEB, 2021)

Figure 86: BD4 Old building classroom

Figure 87: BD4 Old building corridor

Figure 88: BD4 Library and Computer Lab

Figure 89: BD4 Community engagement goals

The new building design was the typical linear model with a total of 28 classrooms. Classroom capacities were 42 students per class. They had smart boards installed in the front, projectors, and bulletin boards on the back wall. Classes lined both facades with a central corridor serving them. All staircases were barred with steel. (Figure 90,91)

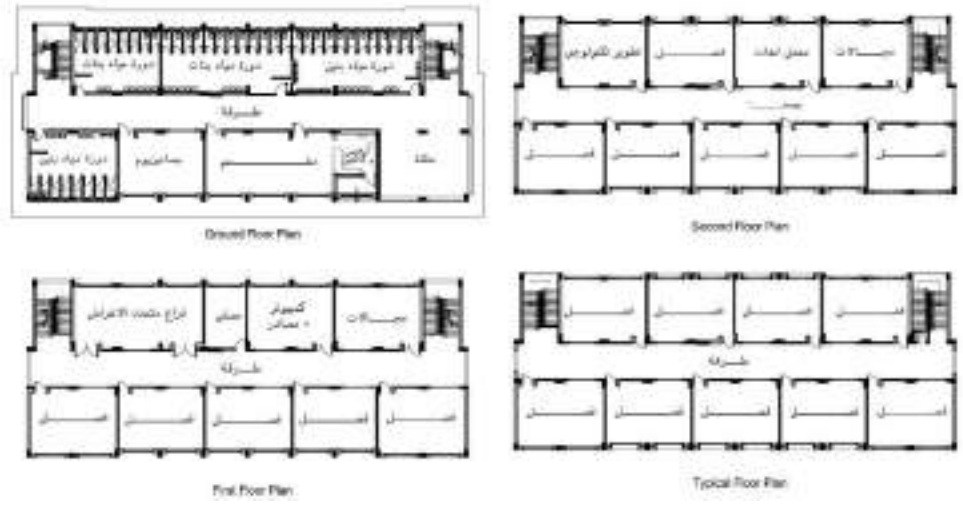


Figure 90: BD4 New building floor plans (GAEB, 2021)

The outdoor spaces consisted of a central sand school yard surrounded by the old building with benches around it, and another preceding the new building. A small, tiled area also served the new building with some trees lining its perimeter. The level difference between both sites was used as stepped seating and lined with trees. (Figure 92)

Figure 91: BD4 New building

Figure 92: BD4 Outdoor spaces

5.6. Case Studies – Category 5: International Public Schools

The fifth and last category of governmental school buildings inspected was the International Public school (IPS). Unlike the categories preceding it, IPS falls under the administration of the Ministry of Education directly, not under the districts' educational administrations. Since only 14 schools exist from this category in Egypt, 12 of which are in other governorates, it was not possible to access them. Additionally, only a few of these schools are operating since they are still newly founded. Therefore, only one school was visited, located in East Nasr City on May 20th, 2010.

5.6.1. ENC5

This IPS school building was originally designed to be an Experimental school. Yet after construction it was changed into International Public. Therefore, the general components of the complex are the same as those observed before, with two buildings holding all educational spaces, and a large school yard. Only Kindergarten to the second primary stage have been enrolled, and the older years will begin enrolment starting this year.

The buildings were the linear prototype with a central double loaded corridor with staircases at each end. It was noticed that the buildings' finishing materials were of higher category than those before it, tiled with ceramics instead of standard mosaic tiles. The outdoor spaces were being lined and divided into different sports fields, yet not yet finished. (Figure 93) The school entrance overlooked the kindergarten area which had artificial lawn installed.

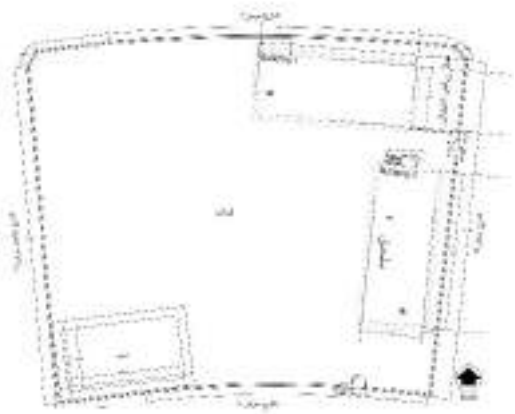


Figure 93: ENC5 School Layout (GAEB, 2021)

The ground floor of the eastern building contained bathrooms, and a large, arcaded area open to the school yard and two classrooms, one of which was replaced with the headmaster's office. The ground floor of the northern building had the bathrooms and the kindergarten classrooms. The upper floors were lined with classes and labs on both facades. (Figure 94)

The classrooms were again a standard 40m^2, yet their furniture and capacities were totally different. Instead of the standard three rowed classroom, with benches attached to the desks for two students each, these classes held individual desks. Different desk geometries were found as well as colours, and some desks were set in pairs or grouped in fours or fives. Each of the classrooms was decorated according to a different theme for each of the different years. Three of the most prominent were the Jungle theme (Figure 95), the Space theme (Figure 96), and the Rainbow theme (Figure 97). Themed decorations of each class started at the door and extended to the classroom interior, where even the bulletin boards were themed, and some installations hung from the ceiling such as an astronaut model in the Space themed classroom, and a tulle rainbow in the Rainbow class corner.

Other furniture included open lockers for storage and for students to use, a flat screen in the front of the class instead of a board, bulletin boards lining the rest of the walls and some educational material even hung from the ceiling. The front wall of each class had pictures of the students in that grade hung on it, as well as some educational material, classroom rules and ethics, and motivational quotes. (Figure 98) Floorings, which were standard tiling in other schools, were vinyl in this school, giving a wooden flooring look. Windows were installed with unified coloured curtains. The overall classroom capacity ranged between 19 to 21 students. The school corridor, although not furnished for any other uses than circulation, contributes to the educational process. Divided into sections of different subjects, children's projects, drawings, collages, and pieces of writing were hung on the wall of the whole corridor. (Figure 99)

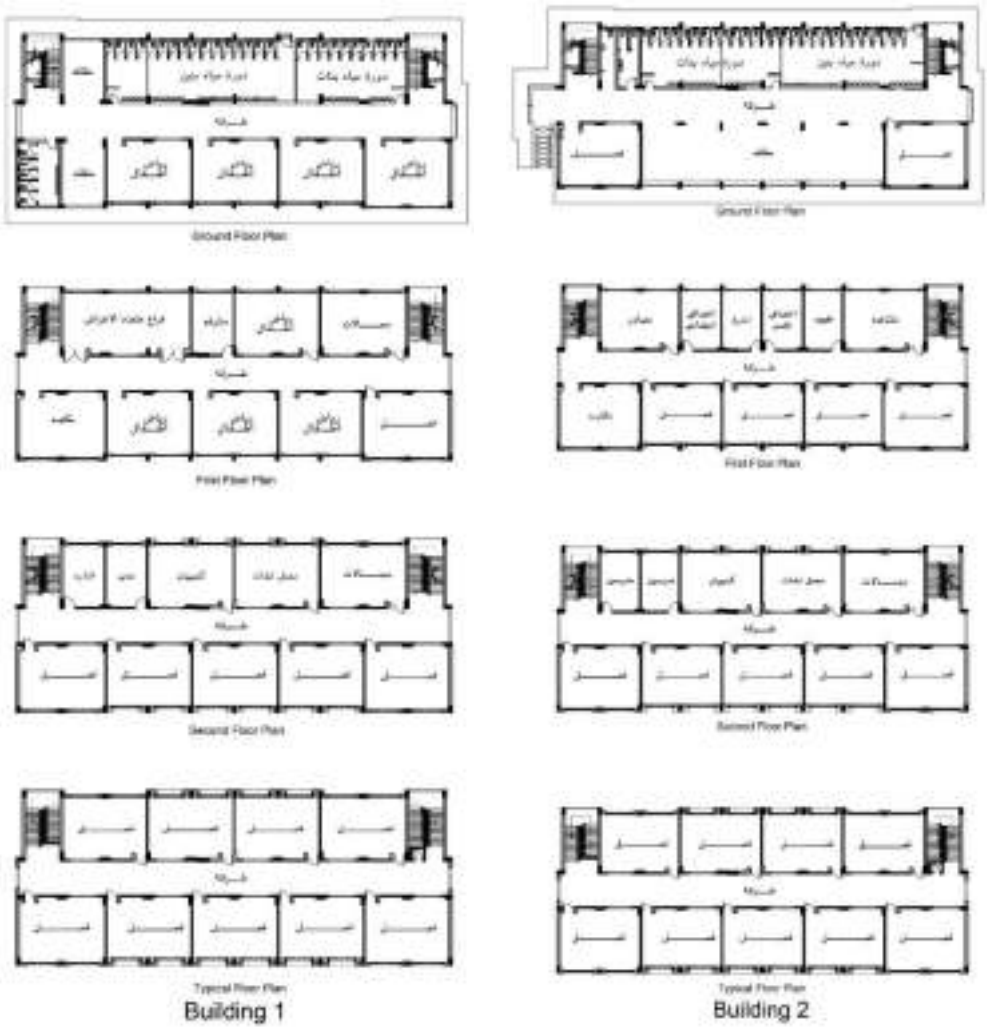


Figure 94: ENC5 Floor Plants - Northern building (1), Eastern building (2) (GAEB, 2021)

Figure 95: ENC5 Jungle themed classroom

Figure 96: ENC5 Space themed classroom

Figure 97: ENC5 Rainbow themed classroom

Figure 98: ENC5 Classroom front wall

Figure 99: ENC5 Corridor

Conclusion

After mapping out the system of how educational buildings are constructed in Egypt, who is responsible for designing and implementing them, and visiting the GAEB to collect data from the architects and engineers, it was clear that school buildings are unified in their design achieving the very specific standards that were set by the GAEB.

Upon visiting the schools, it was also apparent that there are several prototypes of architectural designs generally implemented, and that the school categories do not differ much in terms of spatial design. Only a few components were different with the same modular design overshadowing all five categories of schools, differing only in some minor features.

Although the spatial aspect was covered through the field research, the experience of the users was still a missing matter. Therefore, it was important to find alternative ways to reach both students and teachers to collect their insights.

Insight Gathering: Tools and Techniques

6.1. Questionnaires

The third part of the empirical study was conducting online questionnaires with the users of governmental school buildings since they could not be conducted inside the buildings themselves due to COVID-19 limitations. These users included students of the primary stage and teachers at governmental schools. Since the GAEB is the centralized authority responsible for constructing schools all over Egypt, not just in Cairo, this means that the typical school model is found all around the country. Therefore, the questionnaires did not target residents of Cairo only, but were valid to all Egyptians enrolled in governmental schools.

The first online questionnaire was directed to the children enrolled in governmental schools, ages ranging between 5 – 11 years old (Appendix G). Due to the possibility of inaccessibility of this age group to the internet, or their inability to comprehend the questions, the help of their parents was required.

The second online questionnaire was directed to the teachers at governmental schools (Appendix H). Due to the limitations of COVID-19 and the school year ending abruptly, no teachers were found during the school visits, and reaching them was very challenging. Therefore, the study had to depend on the results of the online questionnaire.

Both questionnaires were prepared based on the literature review and some of the observations of the field work in the governmental school buildings. The first was divided into five sections, namely profile of the respondents, physical information on their school buildings, the users' personal experience, perspectives, and the building quality, and a section reimagining the school building. The final section

of the questionnaire was directed towards parents only, to collect their views on their school buildings in a nutshell.

The second was divided into four sections, the first three like that of the students to gain a holistic perspective on both student and teacher experiences of the building, and the last asking them their personal opinions of the changes and suggestions that need to be made to the school campuses to achieve better education.

To support the target users in answering the questionnaire, it was prepared in Arabic, and to help children comprehend the questions, most questions were in the form of multiple choice, checkboxes, and short answers. Visual material was also extensively used, whether for reporting on their school buildings through real-life photos, 3D Models to imagine different class settings, emojis to help them express their feelings in the classroom, and sample photos of elements that could be incorporated within school campuses to help them reimagine their schools.

The first section of the questionnaires (About You) collected data on the respondent profile such as age, gender, and information about the school in which they are enrolled, or they teach at.

The second section (About your school) collected data on the spatial components of the school buildings (both indoor and outdoor spaces), how they are used, and some numerical data. They were also asked to rate some qualities of the school building, and in the case of the teachers' questionnaire it proceeded to ask them what extent they believed the buildings and facilities of the school impacted their desire to stay employed in that specific school.

The third section (Your school experience) aimed at pinpointing the differences between school buildings, collecting data on the prototype spaces that children have in their schools, and how they feel inside their classrooms. Teachers were asked how frequently they used technology in teaching and on their needs to adapt the classroom furniture. Then both questionnaires proceeded to show different classroom settings such as linear, group U-shaped and mixed seating through 3D models, asking which of the four models best suited each of Collaboration, Communication, Critical thinking, and Creativity (the 4Cs).

The fourth section (IMAGINE!) was a fun section which intended to gather data on how the children would recreate their classrooms and school spaces, and what their needs and preferences are. In case of the teachers' questionnaire, this section aimed at collecting teacher's opinions on what the system lacks, what challenges

they face during teaching, and what they would like to add to the school facilities to promote better education.

The fifth and final section in the first questionnaire was directed to parents, asking them to evaluate the school building and collecting their opinions on what changes are required in the school for their child to gain better education.

6.2. Children's Classroom Co-Design Workshops

The fourth and last part of the empirical study was implemented through carrying out two co-design workshops with primary stage children enrolled in governmental schools.

Figure 100: Ezbet El Nakhl District (Varma, 2018)

The first workshop was carried out on June 5th, 2021, from 10:00am to 1:00pm in Ezbet El Nakhl (Figure 100), a district located on the outskirts of Cairo. Originally a green district named after its prominent palm trees, Ezbet El Nakhl was turned by random urbanization into a slum with mainly Copt inhabitants, traditionally pig farmers who are now also garbage collectors. The workshop was conducted with 17 children, ages ranging from 4 to 12 years old. 10 of the children were enrolled in Arabic schools while the 7 others were enrolled in Experimental schools.

The second workshop was carried out on June 8th, 2021, from 11:00am to 2:00pm in Imbaba (Figure 101), an informal district located in North Giza inside Greater Cairo known for its rapid growth of population. The workshop was conducted with 28 children, ages ranging between 6 to 14 years old. All 28 children were enrolled in Arabic schools.

Figure 101: Imbaba District (Imgur, 2015)

These two districts were selected to ensure the covering of all social classes in Greater Cairo throughout the empirical study, and to observe the awareness of children enrolled in governmental schools that are in informal areas and slums.

6.2.1. Workshop Structure and Content

The workshops aimed at applying many of the theories that were reviewed in the literature, as well as collecting further insights from the children on their school experience, their needs, critique, and what they would like to change. It was also designed to test the children's awareness and capabilities in demonstrating the 21st century skills, whether they were the 4Cs, the Literacy or the Life skills.

Many different forms of media were used (visual slides, sketching, flashcards, collages, and a physical 3D model) to help the children comprehend the information and purpose of the workshop, and to encourage the engagement and incorporation of all the different characters of the children, stressing on the facts that they were all heard and that their individual as well as group skills were portrayed.

The workshop consisted of **five** phases:

1) Introductory Presentation and Brainstorming Session

The first phase was an introduction to the built environment, who makes it, and its components (building materials, elements, spaces, and building types) (Figure 102). Then it moved onto a brainstorming session with slides on the school as a building, its spaces, and the components of a classroom. (Figure 103) The final part of the presentation showed the children different case studies of spaces in schools to portray a variety of options that could be designed within the school premises. (Figure 104) This was for the sole aim of exposing children to the different ideas that are implemented in school buildings abroad since their exposure is limited, and to collect their opinions on these elements, which ideas they agree with or like, which address their needs, and which they see as

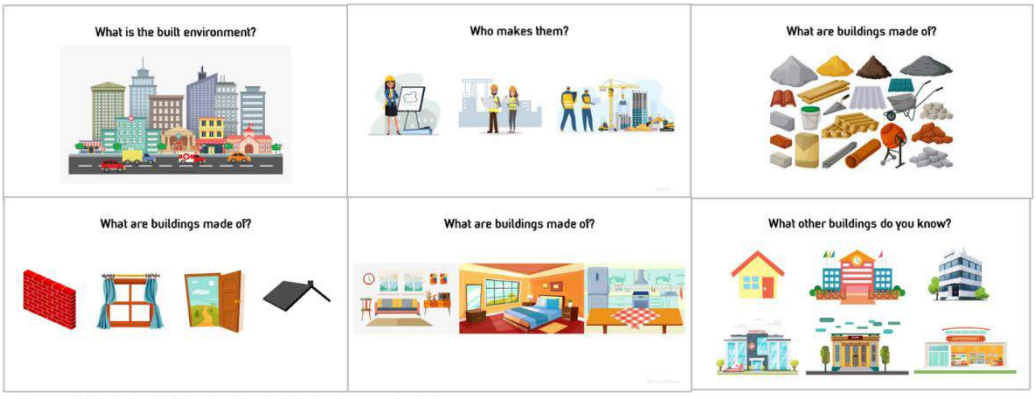


Figure 102: Introduction to the Built Environment slides

unsuitable. This session was designed to practice **Communication** and **Critical thinking** through the presentation, individual input, and group discussion.

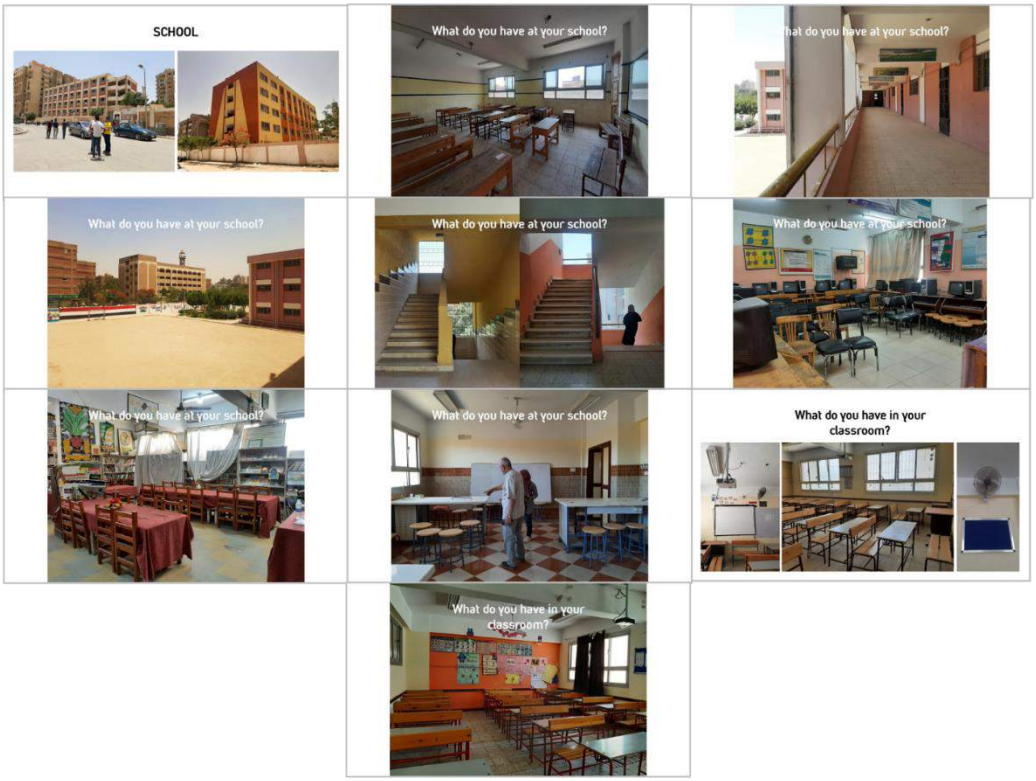


Figure 103: School building slides

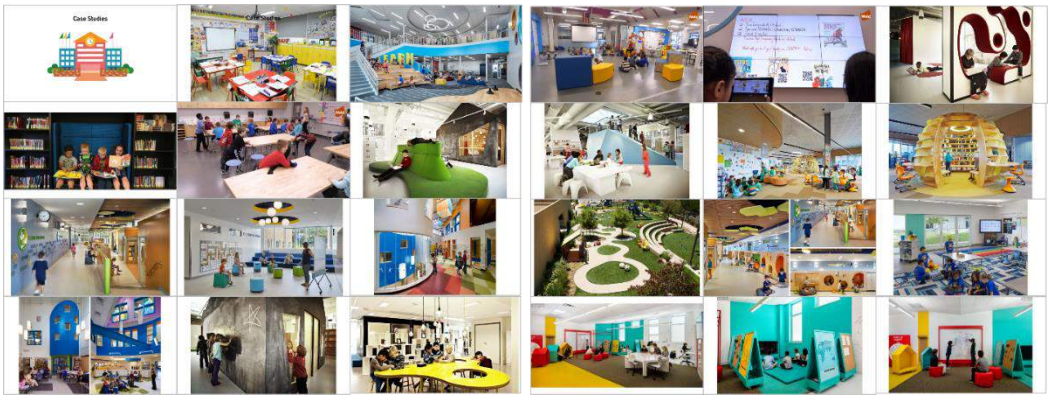


Figure 104: Case Studies slides

2) Reality

The second phase consisted of the children drawing their real classroom setting. It was carried out through giving them blank sheets of paper and coloured pencils so they would sketch them. This activity aimed at inspecting the different samples of classrooms if any, and understanding children's perception of their classroom spaces, in terms of setting, arrangement, components, zones, and in some cases the number of students per class. The session again stressed on **Communication** and **Critical thinking** yet this time through the analysis of the classroom spaces and breaking them down into components, then communicating these settings into drawings.

3) Emoji Expression

The third phase of the workshop was based on children's ability to express their feelings in the different school spaces. Pictures of seven real life spaces were shown to the children (the classroom, corridor, science lab, computer lab, library, bathrooms, and school yard) (Figure 105), and each child was given a set of flashcards with different emojis expressing different feelings (Figure 106). Upon showing each space, they were asked to select which emotion they felt in this space from their array of flashcards and set them on the table in front of them. A count of each of the feelings around each space was then taken to show how the majority felt inside certain spaces. This activity focused on **Communication**.

Figure 105: Seven school space pictures

Figure 106: Emoji flashcards

4) Wish!

After brainstorming with the children on the possibilities that could be added and designed in schools and collecting data on their real-life classrooms through discussion, drawings, and expression of their feelings, the fourth session was designed for the children to individually re-imagine the classroom space. They were given pictures of a set of elements and different furniture (Figure 107) and asked to make a collage by selecting the things they wish they had in their classrooms or would like to have. This phase stressed on **Creativity** since it required the children to step out of their familiar state of mind into a creative mindset to begin imagining these new elements in their classes. It also promoted **Critical thinking** because they had to evaluate which element could be added and why, and each child had their individual logic as a justification. The third skill promoted through this activity was **Communication** since they were asked to communicate their wishes and needs through the collage.

Figure 107: Collage Material

5) Classroom Co-Design

The final phase of the workshop was a conclusive session. It consisted of a group activity of co-designing a new classroom that served the children's needs and

wants, and that reflected on everything they had learned through the workshop. It was implemented using a physical 3D model. The classroom walls were erected with the door and windows positioned according to the real-life governmental classroom. The children were then instructed to stand around the model, and some material was set out in front of them such as different types of 3D furniture (Figure 108), elements that could be hung on the walls, and some others that indicated carpets and boards, and each child was asked to select an element to place inside the model. The activity was organized so that the children would physically arrange the elements, then criticize and re-arrange them again. This phase portrayed **all 4Cs** (**Creativity**, **Critical thinking**, **Collaboration** and **Communication**), because not only did they design a space, but it was also required from them to imagine something they had never seen, create it, criticize it as a group and make the amendments needed for it to operate, communicating it through a 3D architectural model and verbally.

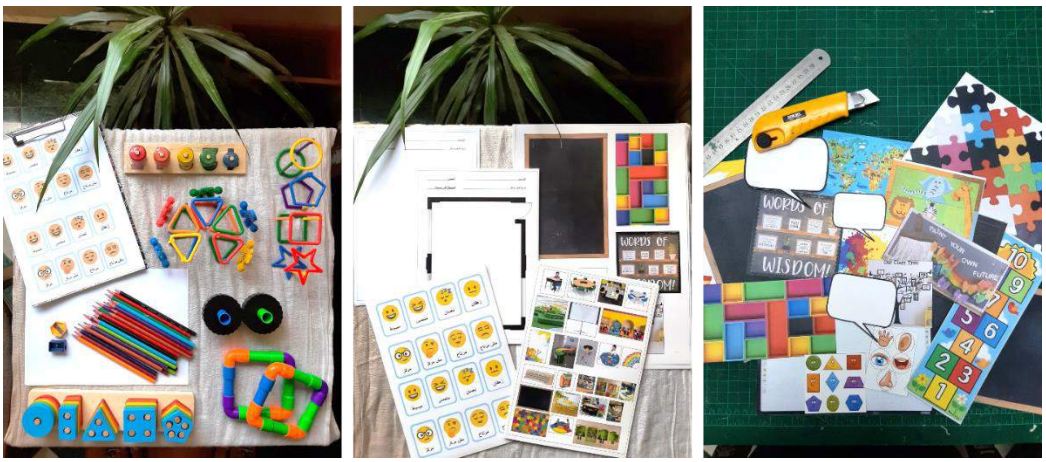


Figure 108: 3D Model and overall workshop material

Conclusion

Since data could not be collected within the school premises the online questionnaires were crucial to gain a holistic overview of Egypt's school buildings. The factor of the unified models and the centralized authority of the GAEB to construct the schools throughout the whole country, gave the questionnaires a flexibility in the array of respondents since they were not restricted to a specific place or model. The building experience is common to all its users, whether children, parents, or teachers, and that aided in the collection of data.

The last part of the empirical study consisted of the two workshops that were carried out with a total of 45 children in both districts of Ezbet El Nakhl and Imbaba. The workshops aimed at displaying the children's awareness of their built environment, especially their schools, and collecting their insight and experiences. The workshops also targeted the use of different media to help the children fully express themselves and stressed on proving that the 21st century skills are embedded in the children no matter their background. They also emphasized practicing the concept of community engagement (21st century school design principle) by engaging the children into the design process to test their capabilities and display their outcome.

IV. Research Findings

The School – User Experience

Upon applying the empirical study to validate the literature review and collect data on the physical design of the Egyptian school buildings, the users' experience and insight on them, and the children's perceptions of their classrooms, many findings were concluded. These findings answered the last two research questions, stating the different school prototypes that can be found in Egypt, mentioning their spatial components and qualities. They also concluded how children experience their schools, also addressing the school's user needs.

7.1. School Visit Findings and Discussion

With regards to the eleven schools visited, and the other six studied through drawings, it was found that the Typical Model is mainly similar, varying only in the composition of the buildings together due to site conditions and population requirements. It was observed that throughout the 17 schools, four building prototypes were found, all variations of the linear model:

a) **The Linear Model:** Central, double loaded corridor flanked with staircases at its ends and classrooms on both facades. This model was the most common, found in ten schools out of 17. (ENC1, M1, BD2, ENC4, ENC5, W1, MN1, MN2, W2, M2)
b) **The U-shaped Model:** Composite form of the linear model with a central linear building and two buildings of lower heights on its left and right. This model was only found in two schools (ENC2, BD4).
c) **The L-shaped Model:** Two adjoined linear buildings, sometimes separated. This was found in four schools (BD1, BD3, M3, W3).

d) The Courtyard Model: Large building incorporating two central courtyards with the corridors and classrooms around them facing the four facades. This was only found in one school (ENC3).

The differences between the school categories were therefore not found in the architectural design of the buildings, but in some components of the school campuses such as extra sports fields, a few activity classes within the building, and in some cases a theatre.

7.1.1. Egyptian Governmental Schools and the 21st Century School Design Principles

In terms of the different categories achieving the 21st century school design principles, and promoting 21st century skills, it was found that some of the schools had a few of the five principles, yet with varying extents.

Regarding **flexibility and adaptability of learning spaces**, all categories excluding the IPS portrayed the same identical layouts of double seated desks attached to benches lining the classroom. This indicates that students are to remain seated in this rigid setting for ease of control, very similar to the industrial "egg-crate classroom". Movement is very difficult with such limited space, and no options of different seating or zones are offered to provide different zones or methods of learning. The capacity of classrooms which reached 50 students by observation exceeds the GAEB's maximum standard, which would make the area per student less than $1m^2$, in turn prohibiting movement.

Only a few schools differed to this condition. For example, in BD3 (Experimental), instead of benches attached to the desks, individual chairs appeared. The placement of a white board in the back of the classroom while a smart board was put in the front could be an indication of both ends of the classroom being used for different modes of learning. In ENC3 (Distinctive), some classes showed a change in furniture setting such as the benches grouped together face to face to provide group seating. This addresses the needs of some spaces to be adaptable and shows that trials are being made even though the resources are limited.

In ENC5 (IPS), the classrooms showcased a new and innovative arrangement of seating, grouping the students instead of isolating them or arranging the desks in their standard row layouts. The desks set together in pairs in a class, grouped in fours and fives in another, in integration with some individual desks, indicates the quality of flexibility and adaptability according to learning needs. The small capacities of the classrooms also allow for children's movement inside the class. This in turn encourages the promotion of the 4Cs since children constantly communicate with each other through learning in groups, as well as many of the Life skills. The thematic design of each of the classes also

helps children develop a sense of wayfinding and belonging to their space, especially having their photos and work on the walls.

Extending learning beyond the classroom was rarely found, where most of the schools showed that learning mainly happens within classrooms. The presence of complementary classrooms such as Fields, Art, the library, a theatre, and other spaces, indicates that learning happens in other spaces. This was further investigated in the questionnaires. Yet corridors for example are strictly used for circulation. Only some cases differed, although not intentionally. For example, in ENC2 (Experimental) and ENC4 (Distinctive), where some benches lined the corridor for use of students or alternative to teacher rooms.

The only school that showed preliminary potential of adopting this principle was ENC5 (IPS), where the school corridors that held students' work hung on the walls indicated that this space is not only used for circulation but as a space where children can display and exchange their learning experience through observation of their colleagues' work, especially those of different educational stages. This is a preliminary approach to creating a learning corridor where children can learn unintentionally and informally.

In terms of **integration of technology**, only one of the Arabic schools (ENC1) had smart boards installed in a few classes, and this was more consistent in the other categories, with technology demonstrated through smart boards and projectors inside classrooms. The only two cases that differed and had a stronger initiative to integrate technology were ENC2 (Experimental), where a server room was provided in the new building, with connections leading to every classroom. This indicated the provision of internet access to every classroom. This is extremely important if 21st century skills are to be adopted, since they give schools stronger connections to the outer world, allow for research, critical thinking, and extend learning beyond the classroom walls.

The second case was in ENC5 (IPS), where boards in the classrooms were replaced with flat screens. When the staff was questioned on how learning operates, they mentioned the use of these screens for digital material that is explained to the students, and that there are internet connections installed to allow for research. This partial implementation of the concept at the young age of primary school encourages Literacy skills and extends learning beyond the classroom walls. It also engages children into the learning process.

With regards to **environmental sustainability**, most of the school buildings were oriented towards the North, therefore naturally ventilated with indirect lighting well provided. Yet in some cases such as ENC1 and BD1 (both Arabic), the classrooms faced the southern façade, therefore suffering from glare and heat. That is why most southern elevations were treated with sun-breakers, and classrooms contained ceiling fans and curtains. In the case of ENC1 (Arabic), the window glass was painted black to decrease the amount of light and glare. In general, the single loaded corridors provided much better lighting and ventilation to the inner spaces. In the case of ENC3 (Distinctive), the two central courtyards provided better natural lighting and ventilation. Yet because of this

design, classrooms were lined on all four facades of the building, which caused them to be oriented towards the East, South and West. This created glare and some heat issues, hence the need for curtains in all classes and the ceiling fans.

Regarding sustainability outdoors, green spaces were scarcely found, either placed in the entrances and prohibited to use (Arabic and Distinctive schools), or not properly designed for use. The only school which had green spaces that incorporated seating was BD3 (Experimental). Trees were hardly found, although some schools had a few lining the perimeter of the school yard. In BD2 (Arabic), trees were only used for the division of the school yard for the separation of the two schools in the same campus. No outdoor classrooms or learning spaces were observed in all schools, and no energy efficiency infrastructure was found either. Some pollution problems were observed such as a sewage leak in M1 (Arabic) which interfered with the school yard. The new building extensions taking place to solve population problems are very common, taking up large areas of the school yards which could instead be used as areas for students.

Finally, in terms of **community engagement,** four out of the five school categories portrayed the principle yet differing in extents and methods. In ENC2 (Experimental) and ENC4 (Distinctive), community engagement came in the form of contributions of some computer screens to the computer lab and books to the library, as well as funding some of the maintenance work. In BD3 (Experimental), the green football field is sometimes rented for playing, allowing the community surrounding the school to access the school facility even outside working hours. The clearest implementation of community engagement was shown in BD4 (Future), where a clear notice was hung in the corridor stating that parents have the right to contribute to decisions related to child development and the future visions of the school. They are also required to help with enhancing the quality of education, encouraging a generation that is capable of social development. It also states that the school infrastructure is additionally meant to serve the community and that the school can depend on the community for any material it needs to achieve its goals. In the case of ENC5 (IPS), social media groups for parents to voice their opinions on the educational process and needs.

Therefore, in conclusion to these findings and the school inspections, it can be seen that while some of the schools have some of the principles required for 21st century schools, some main principles such as flexibility and extending learning beyond the classroom are scarcely found. In addition to that, the principles present are only partially implemented. The main observation was that in all 17 schools, the same rigid building design was present, with either the single or double-loaded corridor. The general standardization of all school buildings is in itself a weak point which still follows the 20th century learning demands and the traditional industrial model. Yet since some measures are being taken in the right direction to serve the 21st century needs, it is important to enhance these interventions, providing more intentional changes that aid in promoting the 21st century skills and learning demands.

7.2. Questionnaire Findings

Upon launching the online questionnaires to gain insights from the students, their parents, and the governmental schoolteachers, it was found that much of the feedback supported the findings concluded from the literature review and the school field visits. Many responses acted as eye-openers showing the needs of children, what they feel in their school buildings and how they would prefer their learning spaces to be. The responses from the teachers were especially enlightening because they showed an insider glimpse of what they would like to change about the current educational process in Egypt.

Data analysis was conducted through adopting the univariate[5], bivariate[6], and multi-variate[7] methodology, to deduce any existent patterns or relationships between the responses for deeper insights and conclusions.

7.2.1. Questionnaire 1 – Students and Parents

A total of 83 responses came in on the first questionnaire targeting students and their parent. Eight of these responses had to be excluded since they came from students enrolled in private schools, which is out of the scope of focus of this paper. Therefore, a total of 75 responses were made: 39 of which were primary students themselves, and the other 36 were students aided by their parents. The responses were received between the dates of June 12th and June 21st, 2021. Only highlights of the responses will be mentioned in this section, yet the detailed responses can be found in Appendix I.

The questionnaire was posted on several social media platforms, and since it was not restricted to a certain geographical area (Greater Cairo), responses were collected from 32 different districts, in nine governorates. (Figure 109)

[5] To analyse a single data variable and examine the value distribution is considered conducting univariate analysis. Univariate analysis, which is categorized as part of the descriptive analysis, is useful to ensure if data variables speak well to the preconceived hypotheses.
[6] Bi-variate analysis requires two variables. This is the beginning of examining relationship between variables.
[7] Multi-variate analysis is the analysis of the strength or intensity of relationships between variables being influenced by third or additional variables. multi-variate analysis is all about analysis of the strength or intensity of relationships between variables being influenced by third or additional variables.

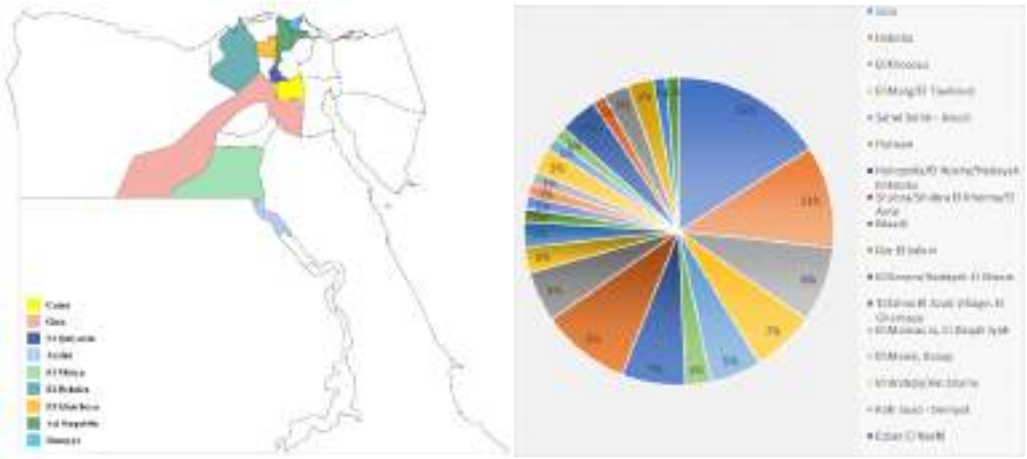


Figure 109: Questionnaire 1 respondents' districts

The responses came from 41 girls (54.7%), and 34 boys (45.3%), with ages concentrated between 7 to 11 years old (Figure 110). 68% of these responses were from children in Arabic schools, highly concentrated in the districts of Imbaba, Giza, El Marg, Ezbet El Nakhl, El Khosous, Shubra, Dar El Salam and all the other governorates outside Greater Cairo. 22.6% were enrolled in Experimental schools, while only 9.3% were listed in Distinctive and Future schools. No responses came in from the International Public schools. (Figure 111)

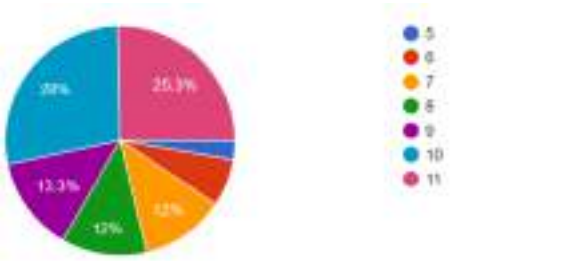


Figure 110: Age of respondents

Figure 111: Respondent's types of schools

The second section, which focused on the physical design of the school and its components, confirmed the results that had been observed in the field visits, where the indoor and outdoor spaces found, were mentioned in the answers.

When questioned if any lessons are taken outside the classroom, 50.7% of the children stated that they only learn inside the classroom, while 49.3% answered yes. This was further investigated (bi-variate analysis) to deduce which spaces they learn in, resulting in the computer lab, the library, and the science lab as the most common.

Ranges	Number of Schools	Percentage	Area/child (min.)
20 – 39 students/class	18	24%	1.02m2
40 – 59 students/class	28	69%	0.67m2
60 – 79 students/class	23		0.5m2
80 & above students/class	5	7%	0.34m2 (40m2 / 115 students in class)

Table 3: Classroom Capacities according to students

The following questions described the children's' classrooms. First, classroom capacities were listed in the answers and grouped into ranges (Table 3). A wide range varied showing a minimum of 20 students/class and a maximum of 115.Yet 69% of the schools showed classroom capacities ranging between 40 to 79 students/class, the bigger percentage ranging between 40 to 59 students/class, mainly concentrated in Arabic schools (37), while also found in 11 Experimental schools and one Distinctive. The standard classroom area (40m2) was then divided by the maximum in each range to determine the minimum area that every child occupies.

Corresponding to these numbers, the highest percentage of students (62%) indicated that 3 students sat in a single desk, while 18% said that they sat in pairs and 10% in fours/desk. Six responses differed from this range, showing a minimum of 1 student/desk (4%) and a maximum of 7 students/desk (4%).

Four 3D Models were visualized to express the different settings of a classroom, and to question the children on how their classrooms were arranged. (Figure 112) 92% of the responses indicated that their classrooms are arranged in linear (row) seating. (Figure 113)

When questioned about the classroom components, the responses showed that while most classes held the common furniture, only 12% (9 responses) appeared to have smart boards, 5.3% (4 responses) and only one classroom had a screen. To allocate which school types had technology, a bi-variate analysis was done with the types of schools. Smart boards were found in all four types of schools, while the projectors were only found in the higher categories (Experimental, Distinctive and Future). The screen was recorded in an Experimental school.

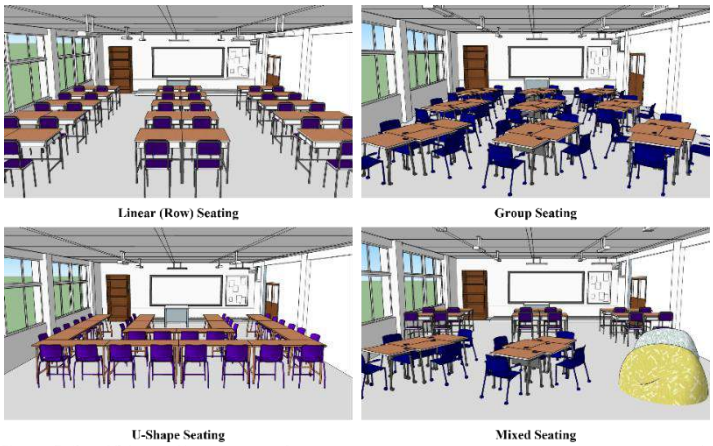


Figure 112: Different classroom settings

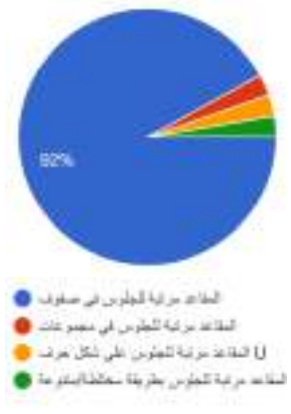


Figure 113: Classroom setting responses

After collecting data on the classroom settings, components, and their design, it was very important to understand how the children felt in these spaces. That is why, a question was posed using emojis (Figure 114, 115) for them to relate and know how to express their feelings in their classrooms.

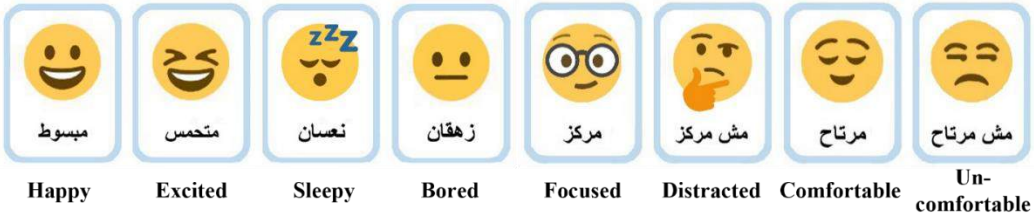


Figure 114: Emojis for expression of feelings

The feelings were reported in the following order:

- 24% Bored
- 21.3% Uncomfortable
- 18.7% Happy
- 9.3% Distracted
- 9.3% Focused
- 6.7% Sleepy
- 6.7% Comfortable
- 1.3% Excited

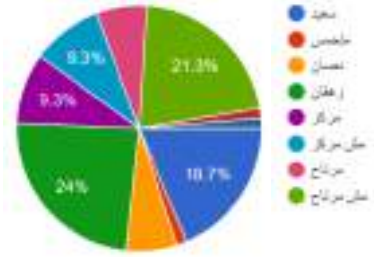


Figure 115: Emotions in classroom responses

To further understand the reasons behind this, a multi-variate analysis was conducted, measuring the data with accordance to the child age. Yet no consistent pattern was found relating the two. Therefore, the data was analysed in relation to the class setting, and the results showed that 60% of the responses that were listed with the highest percentage of Linear (row seating) were associated with negative feelings in the classroom (Bored, Uncomfortable, Sleepy and Distracted) while the other 40% of the responses which were

associated with 29% of the classes having Linear (row) seating were associated with positive feelings (Happy, Focused, Comfortable, Excited) (Table 4).

Although emotions are a subjective variant and could be affected by many other factors, yet this observation shows the impact of one physical factor on the children's emotions. The rest of the classroom settings were fully associated with the positive emotions.

Responses	Feeling	Positive/Negative	Percentage of linear/row seating from total responses
18 responses (24%)	Bored	Negative	17 responses (94%)
16 responses (21.3%)	Uncomfortable	Negative	16 responses (100%)
14 responses (18.7%)	Happy	Positive	12 responses (85%)
7 responses (9.3%)	Distracted	Negative	7 responses (100%)
7 responses (9.3%)	Focused	Positive	6 responses (85%)
5 responses (6.7%)	Sleepy	Negative	5 responses (100%)
5 responses (6.7%)	Comfortable	Positive	3 responses (60%)
1 response (1.3%)	Excited	Positive	1 response (100%)

Table 4: Child emotion in class in relation to classroom setting

The following question asked them to rate specific qualities within their classrooms (Figure 116). The highest two rating for all qualities were Poor (blue) and Fair (Red).

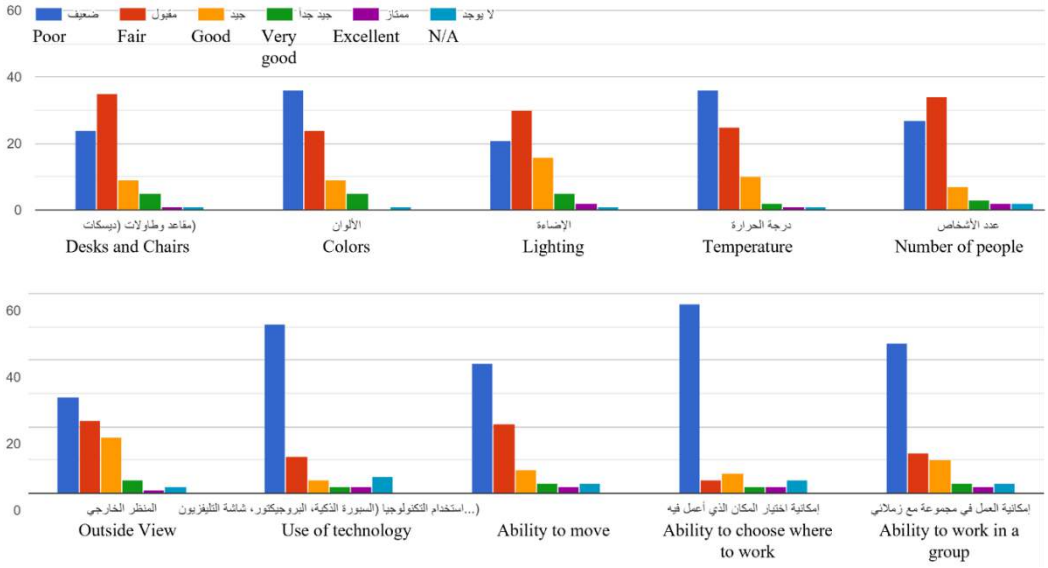


Figure 116: Classroom qualities ratings

To specifically determine if the children are allowed to move in class at all, it was set as a separate question. 81.3% responded with No, while 18.7% responded with Yes. (Figure 117) A multi-variate analysis was then conducted with the types of schools and classroom capacities to see how many students occupied the classes that had answered Yes. Then the responses were divided by the standard classroom space ($40m^2$) to deduce the area a child occupies. (Table 5)

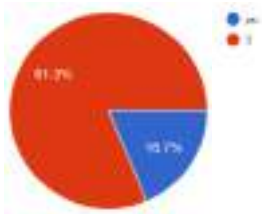


Figure 117: Movement in class

Responses		Type of School	Average Class Capacity	Average area/student
14 total	8	Arabic	40	$1m^2$
	3	Future	27	$1.48m^2$
	2	Experimental	28	$1.4m^2$
1	Distinctive	45		$0.9m^2$

Table 5: School types and Class capacities that allow movement in class according to students.

The frequency of use of technology in learning was reported as 54.7% saying Never, 41.3% Sometimes and 4% Always. To validate this data, a multi-variate analysis was conducted with the types of schools, classroom components, and which spaces are used for learning outside the classroom, assuming that by answering with Always or Sometimes, the children might mean computer classes. (Figure 118) (Table 6)

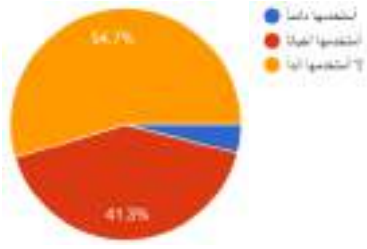


Figure 118: Frequency of technology use

Responses	Frequency	Type of School	Availability of technology	Learning in Computer labs outside classroom	
3	Always	2 Arabic	Not available	Not available	X
		1 Future	Available	Available	√
31	Sometimes	10 Experimental	3/10 only Available	1 only Available	X
		2 Distinctive	Available	Available	√
		17 Arabic	Not Available	2/17 only Available	X
		2 Future	Available	Available	√

Table 6: Frequency of using technology during learning.

To measure the different personalities of the children, and their desire to play inside or outside the school building, or to work individually or in groups, both questions were posed. The responses were almost halved, showing that both options in each category must be made available to cover their needs.

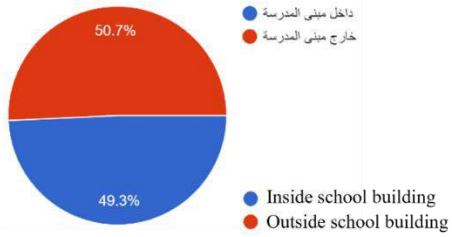


Figure 119: Indoor or outdoor play

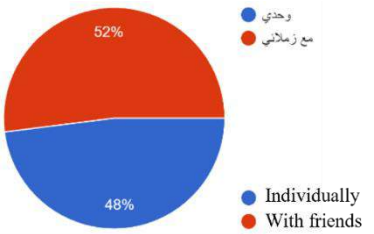


Figure 120: Study in groups or individually

One of the most important parts posed in the questionnaire asked the children which classroom setting encouraged which one of the 4Cs. The 3D models used before were set for them to choose to indicate which setting, they thought encouraged Collaboration, Communication, Critical thinking, and Creative thinking. Results indicated that the Group seating had the highest achievement of all 4Cs. (Table 7)

4Cs	Linear/Row Seating 	Group Seating 	U-shape Seating 	Mixed Seating 
Collab.	10.7%	48%	25.3%	16%
Comm.	13.3%	37.3%	45.3%	4%
Critical thinking	21.3%	28%	33.3%	17.3%
Creative thinking	12%	42.7%	21.3%	24%
		Highest achievement of 4Cs		Highest % Second Highest %

Table 7: Classroom setting achieving 4Cs according to students

In addition to these responses, when directly asked in the fourth section of the questionnaire, how they would like to be seated in class, the highest percentages replied with the Group seating and the U-shape seating. (Figure 121)

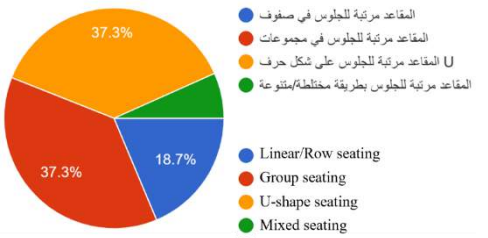


Figure 121: Preferred classroom setting

The fourth section proceeded to collect data on what they would like to add to their classrooms, their school yards, and what they would like to see from inside their

classrooms. Responses are listed in Appendix I. 68% of the children stated that they would like to learn in different classrooms instead of the same classroom, which is an important thing to consider in the educational system itself and while designing the school building.

The last question directed towards the children asked them what would make them happy and excited to go to school. Responses were very enlightening, showing the importance of activities and school facilities (Table 8). Detailed responses in Appendix I.

Activities	0.25%
School facilities	0.23%
Learning and organization	0.14%
Leisure	0.12%
Social aspect	0.11%

Table 8: Hierarchy of categories that would make children excited to go to school.

At the end of the questionnaire, two questions were directed towards parents. The first aimed at seeing if they thought the school buildings their children were enrolled in aided in developing their talents and skills. 74.7% replied with No.

The second and final question asked them what changes are needed for better education. Their responses indicated Nurturing the children and developing their talents, and School facilities (Table 9). Detailed responses in Appendix I.

Nurturing the children and developing their talents	0.45%
School facilities	0.28%
Learning and organization	0.14%
Decreasing classroom capacities	0.05%

Table 9: Parent's priorities for change

8.2.2. Questionnaire 2 – Teachers

Due to the limitations of the study, only a total of 14 responses came in for the teachers' questionnaire. The responses were received between the dates of June 14th and July 7th, 2021. Only highlights of the responses will be mentioned in this section, yet the detailed responses can be found in Appendix J. The questionnaire was posted on several social media platforms, and responses were collected from 9 different districts, in four governorates. (Figure 122)

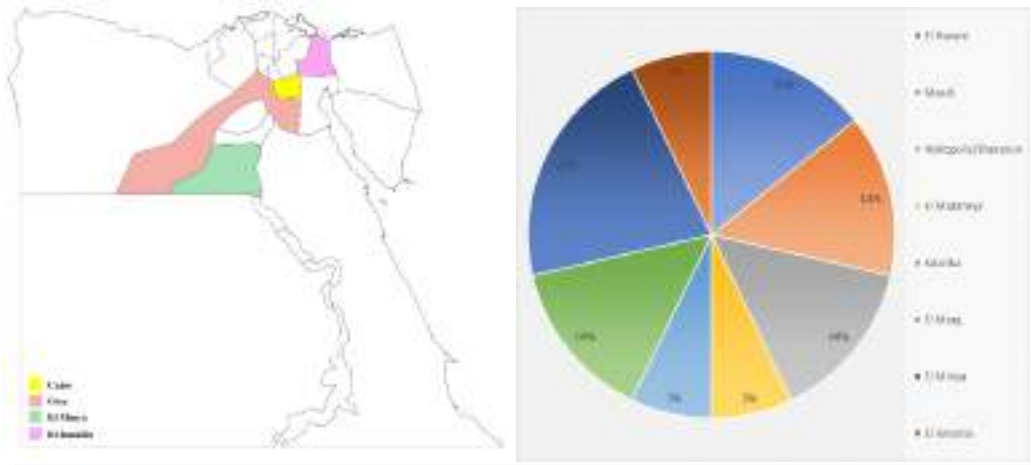


Figure 122: Questionnaire 2 respondents' districts

42% of the teachers had teaching experience ranging between 1 to 10 years. 28.5% were between 11 to 20 years, 21% ranging between 21 to 30, and 7% above 30 years of experience. Most of them taught several grades in primary school, but the highest percentages recorded were fifth and sixth grade teachers. 64.3% teach at Arabic schools, while 28.6% teach in Experimental schools and the last 7.1% teaches at Distinctive schools. No replies were made from Future or International Public schools. (Figure 123)

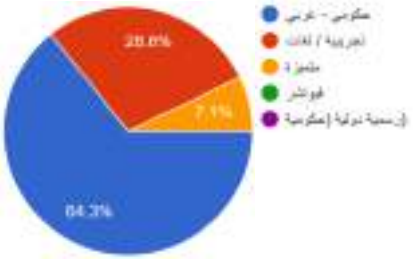


Figure 123: Teacher's types of schools

Like the students' questionnaire, the second part collected data on the school's spaces and how they are used. The questions asking about the school's indoor and outdoor components reconfirmed the field observations and the students' responses. When questioned if they teach any of their lessons outside the classroom, 64.3% replied with No (Figure 124), and the 35.7% that replied with Yes most use the Science and Computer labs.

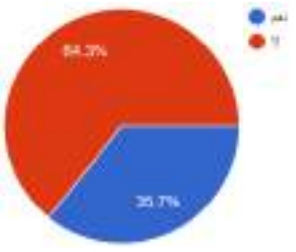


Figure 124: Teaching outside the classroom

When questioned on how the learning spaces are used in their schools, 78.6% of the teachers replied that the same classroom is used for all subjects, while 14.3% said that they use multiple spaces to teach their subject. The rest indicated that they use a specific space for their subject. The following question listed 12 different spaces to check which spaces were used more frequently for teaching, and the results showed that 10 out of these 12 spaces are never used. The spaces sometimes used are the library and the computer labs.

The teachers were then asked to express how much they think the school building and infrastructure affect certain factors. Most responses indicated that the building affects them totally. (Figure 125)

Figure 125: School building effect on different factors

The next question collected data on the common classroom setting (Figure 126) which was analysed using a bi-variate methodology with the types of schools. Responses showed that 85.7% had linear (row) seating, while 14.3% had group seating. U-shape and Mixed seating were non-existent.

The group seating was reported in 1 Arabic school and a Distinctive school. The rest were in Arabic and Experimental schools.

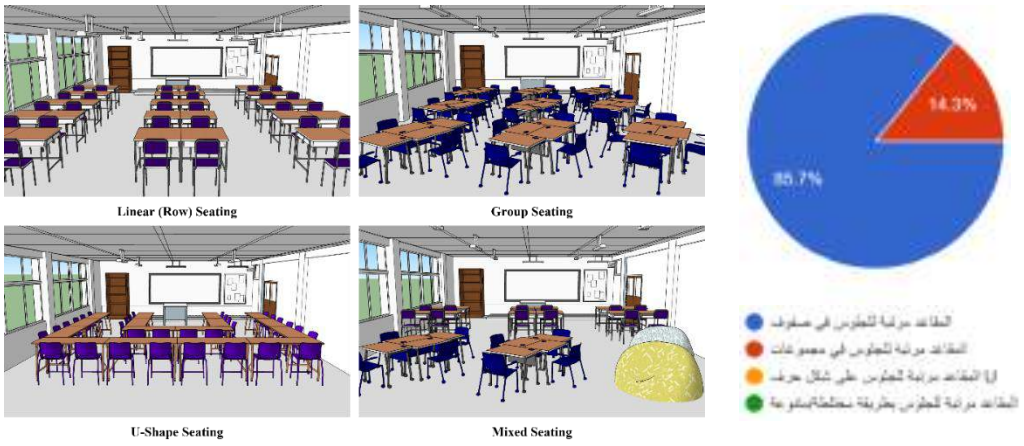


Figure 126: Common classroom setting (Teachers)

Classroom capacities were reported to be less than the children's responses. (Table 10) A wide range varied showing a minimum of 15 students/class and a maximum of 85. The minimum (15 to 20) is highly doubted since that means that if 2 students are sitting in a desk, 7 to 10 desks are found in a classroom. This was not observed in any of the field visits. Yet the teachers could mean the state of 50% of the students attending due to COVID-19, which was reported by one of the students. The biggest percentage of schools showed classroom capacities ranging between 20 to 59 students/class, the bigger percentage ranging between 20 to 39 students/class, mainly concentrated in Arabic schools (6), while also found in 3 Experimental schools and one Distinctive. The standard classroom area (40m2) was then divided by the maximum in each range to determine the minimum area that every child occupies.

Ranges	Number of Schools	Percentage	Area/child (min.)
Less than 20 students/class	1	7%	2.6m^2 (40m^2 / 15 students in class)
20 – 39 students/class	6	43%	1.02m2
40 – 59 students/class	4	28%	0.67m2
60 – 79 students/class	2	14%	0.5m2
80 & above students/class	1	7%	0.47m^2 (40m^2 / 85 students in class)

Table 10: Classroom Capacities according to teachers

With regards to the children per desk, 50% of the responses pointed to 2 students/desk and 29% reported 3 students/desk. 21% reported 4 students/desk and above.

In terms of classroom components, the responses showed the common elements observed in the field work and in the children's responses. Yet surprisingly, the answers indicated that none of the 14 schools had any technological devices in the classroom, whether it was the smart board, projector, or screen.

The third section of the questionnaire collected data on the teachers' personal experience in the school. The responses showed that 64.3% use technology sometimes, while 28.6% never use it. Only 7.1% use it always. This data was again validated through multi-variate analysis like that of the students. (Table 11)

Responses		Type of School	Average Class Capacity	Average area/student
6 total (Yes)	4	Arabic	55	0.72m^2
	1	Experimental	30	1.3m^2
	1	Distinctive	25	1.6m^2

Table 11: Frequency of using technology during teaching.

42.9% of the teachers stated that never need to change the furniture setting of the classroom while teaching, while 57.1% varied in responses between sometimes, most of the time and always needing to. (Figure 127)

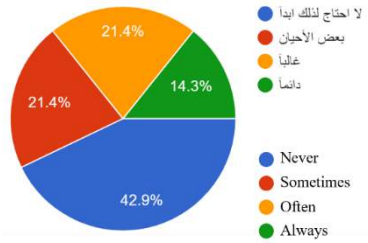


Figure 127: Rearrangement need frequency

57.1% of the teachers replied that children are not allowed to move in their classrooms while 42.9% said that it was permitted. A multi-variate analysis identical to the student questionnaire was then conducted with the types of schools and classroom capacities to validate that movement is indeed possible spatially. (Table 12) Results showed that it would be very hard in the Arabic school and is a slim change in the Experimental and Distinctive.

Responses	Frequency	Type of School	Availability of technology	Teaching in Computer labs outside classroom	
1	Always	Arabic	Not available	Not available	X
9	Sometimes	5 Arabic	Not available	2 only Available	X
		3 Experimental	Not available	Not available	X
		1 Distinctive	Not Available	Available	√

Table 12: School types and Class capacities that allow movement in class according to teachers.

Like the children's questionnaire, the teachers were also asked to select which classroom setting encouraged which one of the 4Cs. Results again indicated that the Group seating had the highest achievement of all 4Cs. (Table 13)

4Cs	Linear/Row Seating 	Group Seating 	U-shape Seating 	Mixed Seating 
Collab.	7.1%	57.1%	7.1%	28.6%
Comm.	14.3%	50%	21.4%	14.3%
Critical thinking	35.7%	28.6%	28.6%	7.1%
Creative thinking	14.3%	50%	-	35.7%
		Highest achievement of 4Cs		Highest % Second Highest %

Table 13: Classroom setting achieving 4Cs according to teachers.

When directly asked how they would like students to be seated in their classrooms, 57.1% of the teachers again responded with group seating, while the other 3 settings got equal percentages of 14.3%.

Finally, four open ended questions were posed, asking the teachers about what they thought the Egyptian educational system lacked, what challenges they face when teaching, what would make their jobs easier and more enjoyable, and what changes need to be made for better education. Their responses were grouped in Tables 14, 15, 16 and 17, each corresponding to the questions, respectively. Detailed responses can be found in Appendix J.

Learning and organization	0.79%
School facilities	0.21%

Table 14: Educational System lacks

School facilities	0.43%
Classroom Capacities	0.36%
Learning and organization	0.21%

Table 15: Challenges faced in teaching.

Learning and organization	0.50%
School facilities	0.50%

Table 16: Elements that would make teaching easier.

School facilities	0.43%
Learning and organization	0.29%
Nurturing the children and developing their talents	0.14%
Decreasing classroom capacities	0.14%

Table 17: Changes needed for better education

In conclusion to both questionnaires, the responses showed that while some potentials of achieving the 21st century principles in school design exist, many measures need to be taken to fully achieve the five design principles of 21st century schools. It was interesting to see results from the 10 different governorates reinforcing each other and relaying the same experiences.

It was found that:

- **Flexibility:** almost non-existent,
- Movement in the classrooms is either prohibited or restricted due to high classroom capacities.
- Both children and teachers picked the group seating layout for the classroom to enhance the 4Cs.
- **Extending learning beyond the classroom**, learning only took place in other classes such as the library, compute lab and science lab.
- **Integration of technology** was only found through the usual smart boards and projectors.
- **Environmental sustainability** (Indoor Environmental Quality): acceptable or good.
- The green spaces were lacking in all schools.
- **Community engagement**, no obvious statements were reported

7.3. Workshop Findings and Discussion

As referred to in the empirical study, the fourth part of the field work was conducted through applying two classroom co-design workshops with primary stage children from governmental schools. These workshops were to implement the previous theories, further validate the data collected from the school visits and questionnaires, and to collect live insights from the children, engaging them in a new classroom design proposal. Samples of the responses will be shown in this section.

The first phase of the workshop, which was the introductory presentation and brainstorming session, reflected much of the children's knowledge of their built environment, and their awareness of their school buildings and their components. (Figure 128) During the beginning of the presentation, the engagement was surprising, showing how aware these young children understood what cities and buildings were, what materials are used for construction, which elements are supposed to be present in a building, and the design to construction process. They instantly named a large array of different building types, even things they never visited such as banks and corporate headquarters.

Figure 128: Workshops - Phase 1: Presentations

The second part of the presentation focused on the school building, and they were asked to raise their hands if they have the spaces shown in different photos. Results differed between Ezbet El Nakhl and Imbaba (Figure 129). When asked if they were allowed to move inside the classroom, all 45 children responded with No, and some stated that it gets exhausting and boring sitting all day. When shown the corridor and asked what they do in that space, all the children responded running and walking to our classes and the playground. The school yards are used only once a day for playing, eating and sports. The children in Imbaba commented that they liked the library atmosphere because it was quiet and because they were allowed to study with their friends in groups.

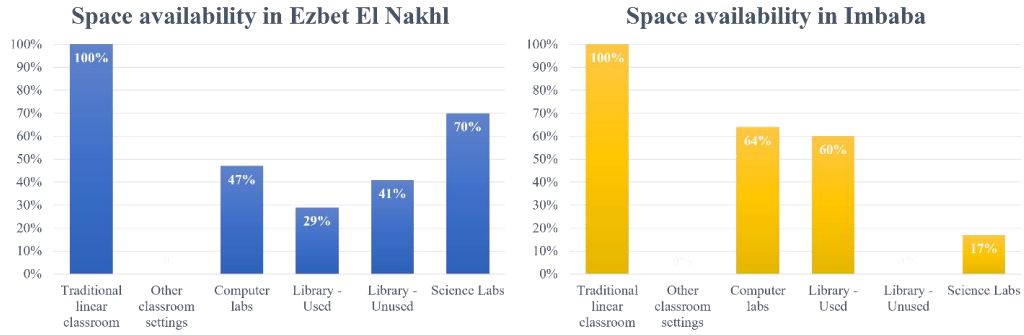


Figure 129: Space availability as reported by children in both workshops.

The third part of the presentation showed the children different case studies of schools abroad and how they implemented the 21st century design principles into their spaces, furniture, and design elements. This section was totally separated from the co-design activity that was required from them, so that they do not imitate the ideas they see directly. What was interesting about this part, was that the feedback came from the children not just showing their fascination with the different ideas, but it showed how their minds associated these different ideas to other building types. In some cases, the ideas were also criticized based on the Egyptian behaviour and context.

For example, when shown this photo of a classroom (Figure 130), they commented that it was a Kindergarten classroom, and when asked why, they said because of the colours and group seating, and that the use of these design elements ended in KG.

When shown this classroom sofa in Vittra Telefonplan, Sweden (Figure 131), the children of Ezbet El Nakhl commented that while it would be very comfortable to have it in their classrooms so they could work in groups or talk with their friends and happily study, it was unsafe because children could fall. It also required larger spaces than their classrooms, and additional facilities they did not have such as laptops. The children of Imbaba refused the idea totally saying it was unsuitable for a school.

This photo of a learning corridor from Discovery Elementary, USA was shown (Figure 132), and the children were fascinated, saying that this was not a corridor but a "break area", commenting that it was foreign to them to have people sitting, studying, and socializing in the corridor. Their corridors were "just for going to class and to the bathroom." All 45 children wanted their corridors to look like this.

Figure 130: Colourful classroom

Figure 131: Classroom sofa in Vittra Telefonplan, Sweden (Bosch, 2012)

Figure 132: Learning corridor at Discovery Elementary, USA (VMDO, 2015)

When shown the learning corridor and double height spaces in Concord Elementary, USA (Figure 133) the children of Ezbet El Nakhl commented that this was "a mall". The same comment came from the children of Imbaba saying that it was not a school and resembled the malls they visited on vacations. The children of Ezbet El Nakhl said that this corridor was very exciting since it allowed space for different activities and connected different spaces, and that the corridors in their schools were "more organized". These observations showed their ability to associate certain architectural features such as a double height space, to commercial architecture, and that it was totally unfamiliar to educational architecture in Egypt.

Figure 133: Learning corridor and double height space in Concord Elementary School, USA

Figure 134: Outdoor area at TVT Community Day School, USA (LPA, 2017)

The outdoor space of TVT Community Day School, USA was shown to the children (Figure 134) and on seeing the green spaces and different activities, the children of Ezbet El Nakhl got extremely excited, yet one of them commented that even if they had this area in their school, it would probably be restricted. The children of Imbaba automatically responded that this was "a villa" because it had green areas and trees. This again pointed to how green areas are only familiar to them in residential architecture.

Each of the pictures shown drew out very realistic responses from the children, and not only were they absorbing ideas, but they also exercised their critical thinking and communicated what they saw and analysed.The second phase of the workshop (Reality) required the children to draw their classrooms. Between Ezbet El Nakhl and Imbaba, all 45 children submitted the exact same layout. Desks were drawn to confirm the setting seen in the school visits, linear divided into 3 rows, with the board and the door in the front, and windows on the left wall. Some elements varied based on their availability in the children's classes, such as fans, posters, teacher desks and number of children per desk. Yet 100% of the children submitted the same drawing. (Figure 135, 136, 137, 138)

Figure 135: Children of Ezbet El Nakhl drawing their classrooms

Figure 136: Sample drawings of Ezbet El Nakhl

Figure 137: Children of Imbaba drawing their classrooms

Figure 138: Sample drawings of Imbaba

The third phase of the workshop (Emoji expression) (Figure 139) required the children to express their feelings in seven different school spaces. Results showed that most children felt happy in the classroom. In the corridor, most children replied that they felt happy and comfortable, because going out to the corridor means they are heading out of the classroom, so it is either break time or they are going home. Their responses in the Computer Lab were between focused and happy because they claimed using technology to learn is fun. Regarding the Library, responses stressed on feeling focused. In the Science Lab their responses varied between excited and focused since they can work practically and observe experiments. The playground indicated happiness, and the bathrooms were referred to as uncomfortable. (Figure 140)

Figure 139: Emoji Expression Activity

Figure 140: Emoji expression results

In phase four of the workshops, the children were asked to create individual collages, selecting the elements they wanted to add to their classrooms. While working on the collages it was observed that while the children were asked to individually submit their collages, they worked in groups of 2 or 3. They said it helped them brainstorm better and be more selective as individuals.

Their results were very different, some picking many elements to add while others sticking to only a few. Coloured furniture and group tables were very common, as well as different modes of seating. Differentiated zones in the classroom allowing for art and reading activities were also selected by a big percentage. Technology was also requested by most of the children. Overall, their selections fortified the needs required for classrooms to achieve 21st century learning demands and showed where the classrooms lack. (Figure 141, 142)

Figure 141: Sample collages of Ezbet El Nakhl

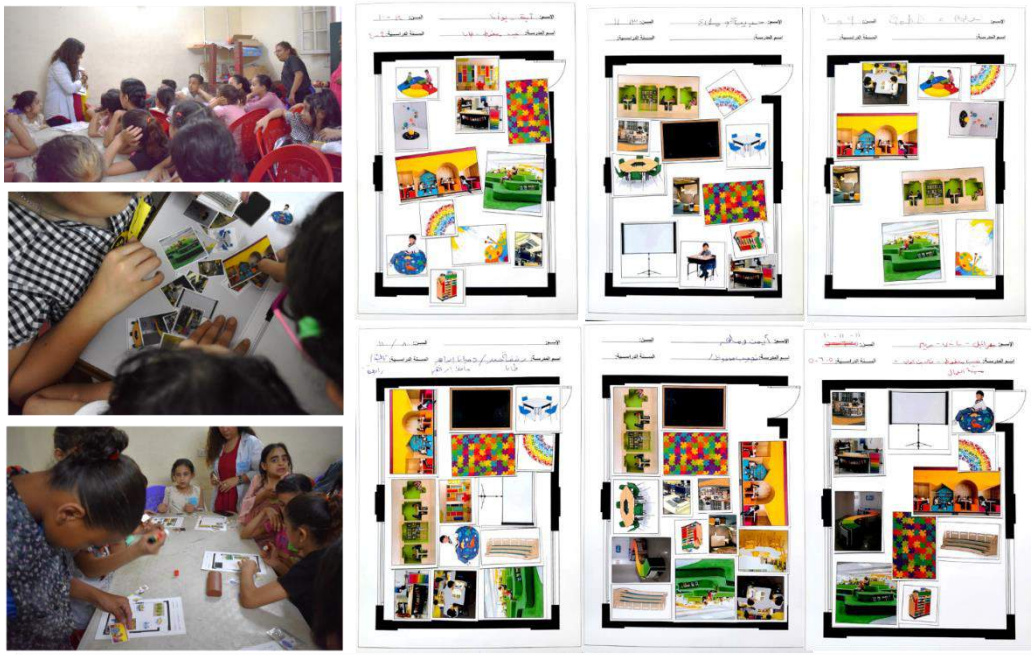


Figure 142: Sample collages of Imbaba

The fifth phase of the workshop and final part of the empirical study was co-designing a classroom space with the children. This activity was meant to collect everything the children had learned, and to investigate if they could design an alternative to their classrooms that functions for the new learning demands they had requested in all the previous phases. It was also meant to portray the children's skills for further community engagement. The design was done through a scale 1:10 physical 3D model that resembled their existing classrooms.

The first thing the children of both workshops did was start arranging different geometric 3D tables into group settings, some linear that children could sit around from both sides, while others were clustered to sit around. Both groups also picked a differentiated geometry (star shaped) for the teacher's desk. (Figure 143)

Figure 143: Classroom seating arrangement (Left: Ezbet El Nakhl, Right: Imbaba)

The second thing that was noticed was that both groups switched the orientation of the classroom, setting the desks in clusters that are towards the back of the classroom, and hanging a smart board there. Therefore, the real front of their classroom that held the door, now was at the back. In addition to that, in the case of Ezbet El Nakhl, the children began arranging activity areas towards the back of the classroom, setting a large carpet for a play area, some bookshelves, and an art zone. (Figure 144) While in the case of Imbaba, after initially setting the clustered furniture to look forward, they rearranged the furniture so that the large carpet could be set in the centre of the classroom for sitting on the ground, surrounded by the different seating. (Figure 145)

Figure 144: Ezbet El Nakhl activity zones arrangement

Figure 145: Imbaba activity zones arrangement

The children then began to evaluate their arrangements based on the new elements they were adding, so the children of Ezbet El Nakhl added been bag seating to the left of the classroom, located around round tables that resemble large wheels. This was to serve the blackboard they added to the left wall of the classroom. They claimed that chalkboards were not outdated, and it would be a good alternative for them than drawing on the walls. In Imbaba, they added one wheel at the front of the classroom while the other was set at the back towards the door. When asked why, they replied that comfortable seating is

needed everywhere so that when they are exhausted from the desks, they can move but still be able to focus on the lessons. They also said the beanbags suited both lessons and activities. A blackboard was also set on the left wall of the classroom, and a white board on the right wall. It was noticed that they were very low on the wall, so when the children were asked to justify, they said "because we can't reach higher!".

Figure 146: Different seating, wall elements (Left: Ezbet El Nakhl, Right: Imbaba)

Therefore, showing the intentions that these elements were for them, not meant for the teacher. A screen was also added above the blackboard on the left wall (Imbaba), while Ezbet El Nakhl group set it on the back wall by the door, claiming that the carpet at the back could be used for movies and presentations. (Figure 146)

The final touches were added by adding bookshelves and student pictures, motivational quotes, and posters on the walls. A brief discussion was then held to analyse the new setting of the classroom. Both groups of children claimed that the seating had to be centralized in the classroom to overlook the four walls, and while the teacher's desk was set at the front, the group seating would require them to move around. The smart boards and the TV screen added an indication that the children required technology for learning. They also asked if they could incorporate a computer in the classroom. The final products were extremely innovative, showing the children's needs and preferences for their classrooms (Figure 147). They also portrayed their skills, whether the 4Cs, their life skills and individual qualities, and their capability to be incorporated into the design process with minimal introduction to the concept.

Figure 147: Final Classroom Design (Left: Ezbet El Nakhl, Right: Imbaba)

When asked who would be excited to go to school if they had this classroom design they came up with, both groups raised their hands and got extremely excited. When they were then asked if they would like to participate in designing their schools as part of community engagement, they replied “Of course! We have to say what we want because we are the ones using the classroom.

Figure 148: Workshop participants (Top: Ezbet El Nakhl, Bottom: Imbaba)

V. Discussion, Recommendations and Conclusion

Towards 21st Century School Design in Egypt

8.1. Discussion of Findings

The four parts of the empirical study worked on exploring the hypothesis raised in the research problem, indicating that Egyptian governmental school buildings do not serve 21st century learning. By visiting the GAEB and investigating the different school building standards, types, categories, and architectural models they presented as designers, it was concluded that until this day, educational architecture in Egypt is mainly standardized. The existence of the Typical Model is a strong indicator that Nasser's intervention for mass education is still ongoing by replicating the same building to save resources. The unified questionnaire responses coming in from 10 governorates also point to the vast standardization not only in Cairo but all over Egypt.

The building standards themselves proved to be restricting. While capacities in the classroom are set to a maximum of 40 students/class in the GAEB's standards, the school visits and questionnaires indicated that this number has been surpassed. In a standard classroom, which is 38 to 40m^2, if there are exactly 40 students, each student will be entitled to 0.95 - 1m2. This clearly indicates that movement in the classroom is prohibited, and that the principle of flexibility and adaptability is extremely hard to achieve. Since the classrooms hold even higher numbers, reaching 80 students as a common number, therefore children are only granted 0.5m2, most reporting that each desk holds 3 to 4 children. This indicates a large problem in capacities. The common building extensions overtaking the school yards further point to that.

Another restricting standard is the corridor width. The width of a single loaded corridor is 2.4m, while that of a double loaded corridor is 3m. This was indeed confirmed in the field visits and through investigating the drawings, and it shows that corridors are not spatially designed for anything other than circulation. Even the questionnaire responses

indicated that. This hinders the ability to extend learning beyond the classrooms. Incorporating any learning activities in the corridor would be spatially impossible. It is therefore crucial that the GAEB's standards are revised and reset, to allow for school infrastructures to serve the 21st century learning demands.

Visiting the school buildings, it was found that the Typical Model was a standardized replica in all schools no matter their category, only changing in variations that serve the numbers. All 11 schools had the same long corridors with 10 of them having identical linear-set classrooms. Only the International Public School differed, seating the children in pairs or groups. The linear-set classroom promotes 20th century learning since all students are directed to receive from the teacher in the front, making education one sided. It also restricts the children's skills since every child is isolated from the rest and is presented with unified information that they must memorize and be tested upon. That leaves no space for creativity, critical thinking, collaboration, or communication. Life skills are not portrayed either in this rigid setting, since the children are all taught as if there is no difference between them.

Activity areas were non-existent inside the classrooms. No zones inside the classrooms indicated any alternative learning methods. All activities were in enclosed complimentary spaces such as the Art room, the library…etc, which were reported to only occasionally be used. The absence of these elements in the classroom again hinders the 4Cs, and their presence behind barred gates and in enclosed spaces means that they are not accessible outside lesson time, if any. In the case studies, when these spaces were located inside the learning spaces, children expressed more creativity, communication and collaboration. The integration of the library and media areas with the corridor also proved to be very successful in providing informal learning for the children, and building their relationships with teachers, which was specifically requested by a teacher in the questionnaire responses. In addition to that, 60% of the children answering the questionnaire requested the addition of an art area in the classroom, and parents stressed on nurturing the children's talents in their responses. In the workshops, both groups added reading and art areas to the classroom design in the model, and most children picked them for the collage as well. Therefore, it is essential to overlap learning experiences in the same places for richer education.

The school facilities differed in terms of technology, some having smart boards and projectors, one with internet and the IPS having screens instead of boards in the classroom. Yet more consistency is needed to achieve the principle of integration of technology more fully. It must be intentionally supported in the learning process and curricula that children must be research oriented. To serve a knowledge-based economy, and be prepared for global exposure, embedding the 21st century learning skills of Literacy is essential. It requires children to be familiar with technology, and with gaining information beyond the classroom walls, and that is a daily demand.

The absence of any energy efficiency infrastructure was also noticed, although many of the campuses could support them. The only implementation of environmental sustainability was through orientation, providing natural lighting and ventilation. Yet

even these factors were not fully implemented, where some schools' classrooms were oriented towards the south, and some added curtains or glass paint to amend light or heat problems. Therefore, environmental aspects were at the expense of numbers of students. Furthermore, it is important to cut costs from things such as lighting and ventilation, and better invest them where they are more necessary.

With regards to the outdoor spaces, some schools had a wider variety of outdoor facilities than others. Yet this proved that it was not according to the school category, but rather to the site conditions. The lack of green spaces was noticed and reported from most children in the questionnaires. In the workshop, they even said they had green areas but were restricted. The questionnaire results showed that 70.7% preferred seeing a green area view from inside their class, and 49.3% wanted to see trees. 52% asked that green spaces are added to the school yard, while 45% asked for a planting area while 64.3% of the teachers asked for outdoor classrooms. This indicates the importance of providing natural scenery and elements, as well as outdoor educational facilities.

Some of the schools visited depicted the principle of community engagement in different methods, showing how the surrounding community was partially allowed to be involved. Whether the engagement was financial, physical, or through being involved in the evaluation of the educational system itself, it is a positive indicator. Yet this only appeared in four out of eleven schools. Therefore, it is extremely important that this principle is made consistent, since schools serve not only the community directly enrolled, but the surrounding community and Egypt as a whole. In the case studies, community engagement in the design process proved to be vital since it guaranteed covering the needs of all stakeholders involved. The children also provided more holistic insight of their experiences of the school building, their needs, and their preferences.

This concept was shown through the questionnaires directed to both students and their parents, and teachers. While the first part of the questionnaire showed the student and teacher experiences of their schools, the rest of the questionnaires showed what students and teachers aspired their schools to be. They expressed how they needed the shift of education to group work and focusing on individual talents, incorporating activities, technology, and new learning methods instead of memorization. While it was totally unexpected that teachers would be flexible towards shifting their traditional systems into the 21st century learning, it was apparent that they needed the same changes that the children and parents required.

The workshops only strengthened these points, portraying what the children would choose if the design were up to them, and how the skills that 21st century learning is addressing are already embedded in them. Through their feedback on their schools, they highlighted the problems they face daily, and by brainstorming on the case studies shown to them, they displayed excellent analytical and criticism skills, expressing that while some ideas were "cool", they would not work for the Egyptian society or the classroom capacities. When they were asked to express their emotions in different spaces, it was clear how subjective this variable is, yet patterns were observed in both the workshops

and questionnaires. The most surprising activity was that of the classroom redesign. Although these children come from slum areas, therefore minimal exposure, they showed excellent design skills, especially taking into consideration their young age. They clearly expressed their preferences, evaluated the setting, and made the amends. They boldly showed the 4Cs in the process, as well as initiative, leadership, and many others. This indicated that even with the smallest effort of introducing children to architectural design through a half hour session, they were capable of proposing spaces that expressed all their needs and wants for the learning process, coming up with designs that they expressed would make them "excited and happy" to go to school.

All these findings confirm the need for a shift in the Egyptian educational system, and a primary need to address the current community through a mindset of this era. The focus on 21st century learning demands and developing the 21st century skills of children has become vital, since this is an era where the unknown outweighs the known. Continuing to use the industrial based, 20th century learning techniques will not suffice, and will not prepare the children for what they will likely face in the future.

In that light, it must be understood that educational buildings and infrastructure have a vital role in raising a strong generation for the future and promoting a successful learning process. School buildings must shift in design, be rid of the standardized industrial prototype, and focus on individualization, promoting skills and innovative learning. The study showed how the buildings could achieve that by highlighting the 21st century school design principles and putting them into practice.

It is therefore vital to understand the aims of education in this era, ridding the system of outdated ideologies that were based on industrialization and mass education, and focusing on each child as an individual; nurturing their talents and skills, in turn preparing stronger generations to serve the community.

8.2. Recommendations

Through reviewing the literature, conducting the field visits to the schools, and investigating the user feedback through both the questionnaires and workshops, a set of recommendations can be made with regards to the case of Egyptian governmental schools to serve the 21st century learning demands. These recommendations come divided on four levels: Pedagogy and Educational System, Standards and Regulations, Spatial Design, Community Engagement.

9.2.1. Pedagogy and Educational System

- Ridding the system of 20th century learning:
    - One way (Teacher-centred)

    - Memorization of information
    - Theory
    - Curriculum
    - Learning for school
- Shifting to 21st century learning:
    - Two-way (Student-centred)
    - Development of skills
    - Practice
    - Life Skills
    - Learning for life
- Incorporating the Framework for 21st century learning by adding Learning, Literacy and Life skills to the learning process and key subjects.
- Multimodal teaching: VARK[8] Model (Figure 149), incorporating art, experimentation, technology…etc.
- Learner-mentor relationship
- Multidisciplinary teaching (curriculum integration) enhancing creativity and critical thinking.
- Teaching lessons in different learning spaces which have the facilities needed.

Figure 149: VARK Model (Lawless, 2019)

9.2.2.Standards and Regulations

- Decreasing standardization of school buildings by taking into consideration all differentiating factors (governorate, context, site conditions. population and community, target aims…etc.)
- Applying strict regulations to the number of students per classroom
- Altering GAEB's design standard indicating $1m^2$/student in the classroom to a minimum of $2.79m^2$/student and a maximum of $4.65m^2$/student (IDB, 2012) to allow for flexibility, movement, and adaptability.
- Wider corridor standards to allow for "learning corridors": integrated informal learning spaces, exhibitions, and social spaces. (Extending learning beyond the classroom)
- Schools designed to be flexible to accommodate estimates of population extensions, to avoid erecting extension buildings in school yards, and compromising the student and staff rights to outdoor areas.

8 VARK: Four modalities of student learning that were described in a 1992 study by Neil D. Fleming and Coleen E. Mills. These different learning styles — visual, auditory, reading/writing and kinaesthetic — were identified after thousands of hours of classroom observation. (KU, 2019)

9.2.3.Spatial Design

- **General**
  - Redefining school buildings into learning spaces, losing the rigid boundaries of the enclosed classrooms with inflexible seating. Shifting to the concept of learning being found anywhere.
  - Transparency between learning spaces and corridors to integrate the learning community and ease monitoring.
  - Merging between learning spaces to create multidimensional learning that enhances the 4Cs, Literacy and Life Skills and nurtures children's talents (ex: classrooms incorporating art corner, reading area, STEM area…etc.)
  - Using colour to enhance student performance.
  - Using the building as a learning tool:
    - Signage
    - Exposed structure system / MEP[9] (ex: exposed beams, elevator pulleys, colour coded piping…etc.) (Figure 150)
    - Outdoor learning environments

Figure 150: Exposed structure and color coded piping at Concord Elementary School, USA (HMFH, 2012)

- **Flexible and adaptable learning spaces**
  - "School buildings that can adapt and bend to meet evolving learning needs" (May, 2011).
  - Flexible classroom zones containing a variety of zones needed for children to learn, adaptable for teachers to use and for children to choose from. This enhances all 12 21st century skills. (Figure 151)
    "These zones could include:
    - Individual study and reflection
    - One to one instruction
    - Peer to peer discussion
    - Small group work
    - Large group work
    - Teacher-directed instruction / Seminar layout
    - Student presentation" (May, 2011)

[9] MEP: Mechanical, Electrical, Plumbing systems of a building

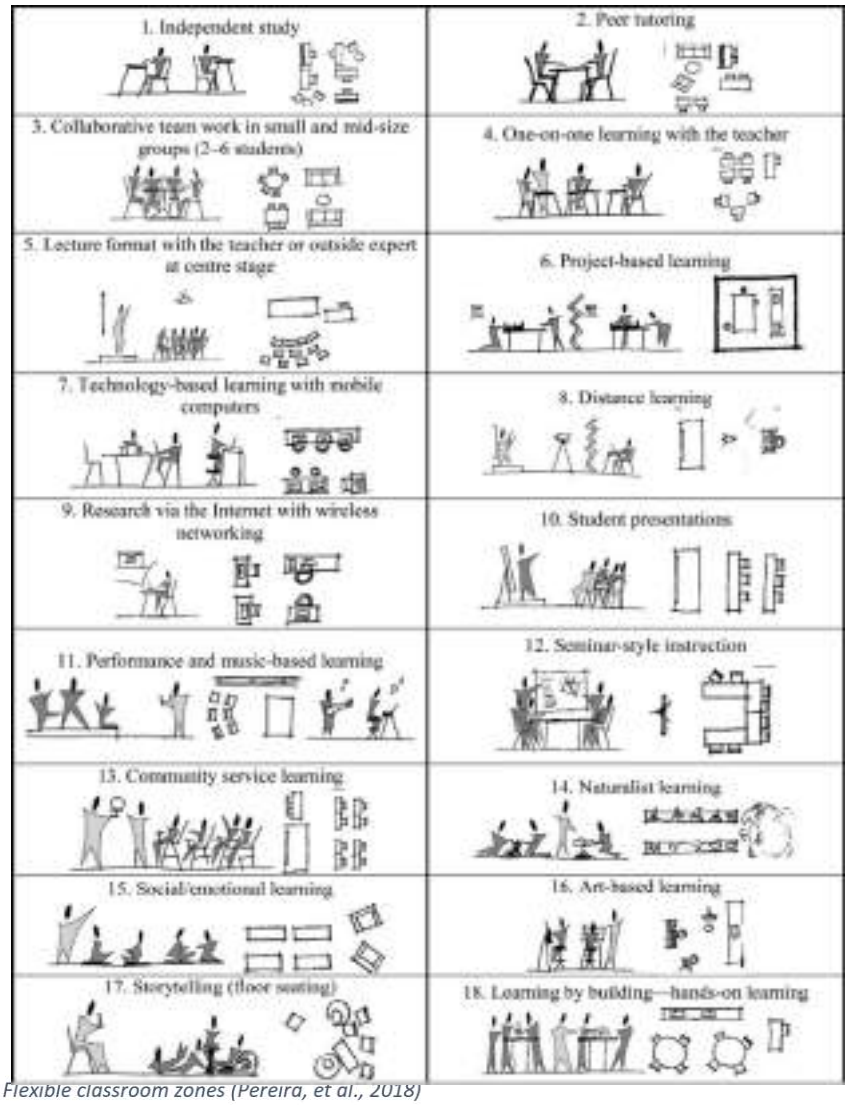


Figure 151: Flexible classroom zones (Pereira, et al., 2018)

- Classroom zoning to serve multiple learning modes and styles. (Figure 152)
- Incorporating flexible furniture and seating that is adaptable to different learning requirements and activities
- Furniture should accommodate children's need to move – "shift position, rock, rotate and roll" (May, 2011). This is critical for their intellectual growth since it enhances attention and concentration.
- Flexible partitions to be used instead of walls to allow spaces to be more adaptable, enlarged, or enclosed, or for merging classes.
- Spaces for multi-age groups to meet, mix and match according to interest.

- Options of non-dedicated spaces that can be shared with others according to needs.
- Indoor social spaces and play area

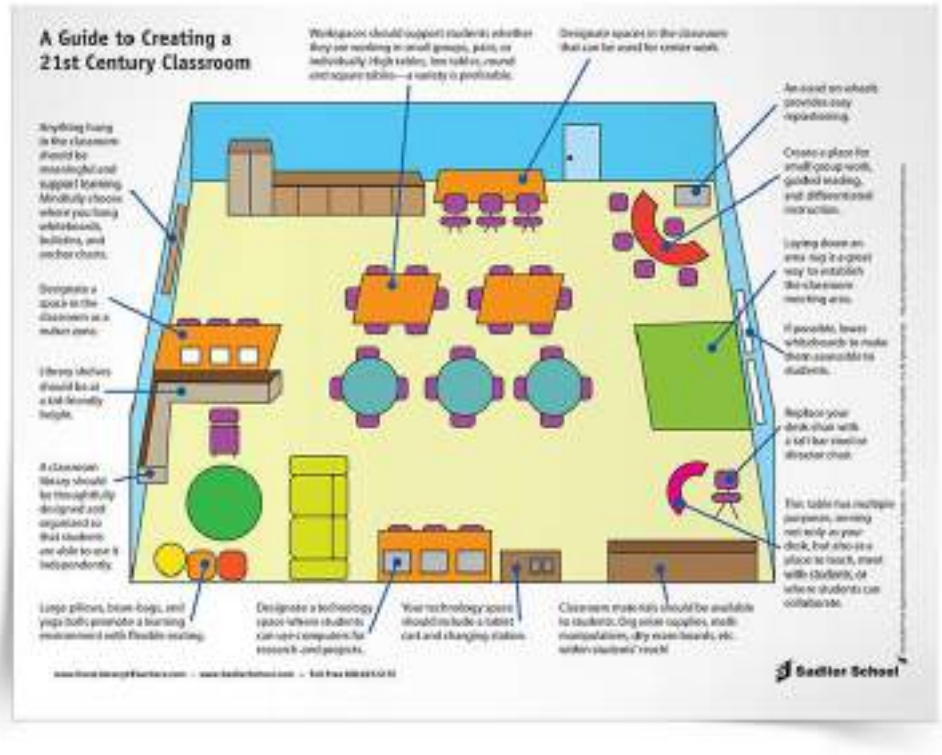


Figure 152: 21st century classroom guidelines (Sadlier, 2021)

➢ **Extending learning beyond the classroom**

- Learning spaces easily accessible by students and staff, therefore, instead of closed complimentary learning spaces (library, multimedia…etc.), elements should be incorporated into learning corridors. This introduces informal learning, bonds between students and staff, nurtures children's talents and develops the 21st century skills.
- Learning material displayed in corridors. Can promote wayfinding if thematic, or student work can be exhibited, which creates a sense of belonging, community, and collaboration. Also considered a form of informal learning.

- **Integration of technology**
  - Continue integrating technology by providing consistent use, allowing portable devices, and providing internet access in all learning spaces. This develops the 21st century skills and extends learning beyond the classroom walls.
  - Provision of computers in classrooms to promote research and critical thinking.
  - STEM labs and technology workshops to be added into school building program, as well as project rooms for inventing, creating, and building (May, 2011).

- **Environmental sustainability**
  - Different measures of environmental mitigation need to be taken since the environmental factors of lighting, ventilation and thermal comfort took the lowest ratings from the school users. They could include:
    - Air shafts
    - Air gaps and double walls
    - Insulation (thermal and acoustic)
    - Green roofs
    - LED Lighting
    - Sensors / "Light flexibility": light that can be adjusted to diverse uses occurring simultaneously in the same space (May, 2011).
    - Double and triple glazing of glass
    - Ideal solar orientation
    - Eco friendly finishing materials / Finishing materials with lower thermal conductivity
    - Biophilia: connection of the building to nature (ex: views, direct access, integration between indoor and outdoor spaces…etc.)
  - Energy saving infrastructure to cut costs and redirect them to more important assets. Can also be used to educate children on environmental sustainability to achieve environmental awareness and literacy (ex: solar panels, geothermal cooling, grey water recycling…etc.)
  - Investing in outdoor learning spaces (classrooms, group seating with boards, outdoor art areas, shaded reading areas, stepped seating, planting areas teaching children how to plant and acting as mini ecosystems…etc.) to extend learning beyond the classroom and develop 21st century skills.
  - Investing and designing accessible green areas to maximize children's exposure to nature, entertainment, and education.

9.2.4.Community Engagement

- All stakeholders must be included in the design process to achieve integrated design that serves the community's needs

- Workshops with children to collect their insights and experience. They are the primary user of a school building therefore their feedback is crucial to what the school design should be. This also helps develop 21st century skills.
- "Districts could involve citizen designers to reinvigorate the design process" (May, 2011).
- Identifying key messages of the building and defining clear aims of learning with the community.
- Parents to have a consistent, periodical role in contributing to the school, whether financially or through evaluation and feedback sessions on the learning process.
- School facilities to serve the surrounding community, where community members can rent spaces or outdoor facilities under conditions or supervision, in turn providing the school with profit.
- Community partnership with the GAEB to contribute with resources for maintenance or upgrading school facilities.
- Partnering with community organizations such as public libraries and sports facilities to provide more services for students (ex: memberships or discounts for cultural activities, stationaries, working spaces…etc.).

8.3. Further Research

Since this scope of study is composed of many interlinked fields, and works on shaping future generations, it is important that education and school architecture are not dealt with in isolation. They should be perceived through the multiple lenses of history and politics, pedagogy, the study of previous cases and educational systems, community and contexts, and architecture. Education must be seen as a primary tool for composing a balanced and developed community that invests in their children and embraces their differences and talents. In turn, school building design must reflect the intended visions that are set for the Egyptian community and its members, and aid in putting these visions into action, in hopes of working towards a better future.

It is therefore vital that all experts of these interlinking fields are contacted by further researchers, to verify the data and collect insights from all stakeholders included. Due to the limitations of this study, only 14 teachers were reached through the questionnaire, therefore further data should be collected from educators, so that their perspective is more holistic. Quantitative data should be collected from many different governorates, and qualitative assessments of the school buildings should be further explored.

Conclusions regarding school design should not be generalized or standardized, since each community and context demands different solutions.

Conclusion

Throughout the paper, it was put into perspective that the traditional school building design that is still being used until this day was generated from an ideology dating back to the era of industrialization and mass education. The mass standardization served that era's demands where children were not required to be unique or creative but required to be disciplined and obedient. While many movements tried to veer away from this ideology taking more student-centred approaches, it was only further sustained post WWII when rapid construction and mass education were required.

In Egypt it was no different. Upon reclaiming Egypt from under the British Occupation, a movement of rapid mass education was led by Nasser, and standardized buildings were erected to accommodate the populations and overcome overhead costs. These buildings continued, and while new types of schools emerged, standardization still overtakes governmental school architecture to this day.

Although we are deep into the 21st century, traditional school buildings are still being constructed, promoting 20th century learning. Since this ideology has become outdated in facing the world's modern needs, shifts in the ideology of education are being made. The Framework for 21st century skills was proposed by P21, promoting Learning, Literacy and Life skills, which are core skills that students need to thrive in today's world. These skills have been reflected by a shift in school building design, incorporating the principles of flexible and adaptable learning spaces, extending learning beyond the classroom, integration of technology, environmental sustainability, and community engagement in many ways. These principles aim at enhancing the learning experience and shifting it from teacher-centred to student-centred and from learning for school to learning for life.

While these principles are widely being implemented abroad, Egypt still follows the standardized "Typical Model"; linear corridors with enclosed standard classrooms holding typical row seating. Throughout the school visits, it was found that the Typical Model was a standard in all governmental school categories, all displaying rigidity and control. Some signs of technology and community engagement showed, yet there was no consistency.

The findings of both the questionnaires only reinforced this, showing how children and teachers used and experienced the building, and how much they need a change in the system and its design implementation. The workshops fortified this point by portraying how children felt about their buildings, their likes and dislikes, their needs, and how they perceived change. Their final designs of the classrooms were strong indicators that all children have the same needs in education, and that education, learning, and school design must flexibly adapt and develop based on the needs of the current era, taking into consideration children's needs, nurturing their talents, and developing their skills, so they can fulfil their roles in their lives, careers, and the community.

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Appendix A – List of Schools

No.	Code	Area	School Type	Educational Stages	Date of Visitation
1	ENC1	East Nasr City	Arabic	Basic Education	May 20th, 2021
2	M1	Maadi	Arabic	Primary Education	May 27th, 2021
3	BD1	El Basateen and Dar El Salam	Arabic	Basic Education	June 1st, 2021
4	BD2	El Basateen and Dar El Salam	Arabic	Basic Education	June 1st, 2021
5	W1	El Waily	Arabic	Primary Education	–
6	MN1	Manshiet Nasser	Arabic	Basic Education	–
7	MN2	Manshiet Nasser	Arabic	Basic Education	–
8	ENC2	East Nasr City	Experimental	Basic Education	May 20th, 2021
9	BD3	El Basateen and Dar El Salam	Experimental	Basic Education	June 1st, 2021
10	W2	El Waily	Experimental	Basic Education	–
11	M2	Maadi	Experimental	Mixed Education	–
12	ENC3	East Nasr City	Distinctive	Basic Education	May 20th, 2021
13	ENC4	East Nasr City	Distinctive	Basic Education	May 20th, 2021
14	M3	Maadi	Future	Mixed Education	May 27th, 2021
15	BD4	El Basateen and Dar El Salam	Future	Mixed Education	June 1st, 2021
16	W3	El Waily	Future	Mixed Education	–
17	ENC5	East Nasr City	International Public	Basic Education	May 20th 2021

Appendix B – Typical Model Spatial Program

Element	Basic Education Requirements				
	11-Class Schools	22-Class Schools	33-Class Schools	44-Class Schools	55-Class Schools
Number of Classes					
Kindergarten Classes	2	4	6	8	10
Primary Education Classes	6	12	18	24	30
Preparatory Education Classes	3	6	9	12	15
Kindergarten Criteria					
Activity Room	1	1	1	2	2
Computer and Multimedia Room	1	1	1	2	2
Principal's Room	1	1	1	1	1
Teachers' Room	1	1	1	2	2
Laboratories					
Science Lab and Preparation Room	1	1	1	2	2
Computer Lab	1	1	1	1	1
Technology Development	1	1	1	1	1
Activity Rooms					
Technical/Agriculture	1	1	1	1	2
Arts	1	1	1	1	1
Music	1	1	1	1	1
Library	1	1	1	1	1
Administration Rooms					
Principal	1	1	1	1	1
Vice Principal + Deputy		1	1	1	1
Secretarial + Finance	1	1	1	1	1
Secretary of Inventory		1	1	1	1
Teachers	2	2	3	4	4
Social Worker	1	1	1	1	1
Multipurpose Room	1	1	1	1	1
Clinic	1	1	1	1	1
Prayer Room	1	1	1	1	1

Source: General Authority for Educational Buildings, 2011.

(Sobhy, 2019)

Appendix C – Arabic School: ENC1

(GAEB, 2021)

(GAEB, 2021)

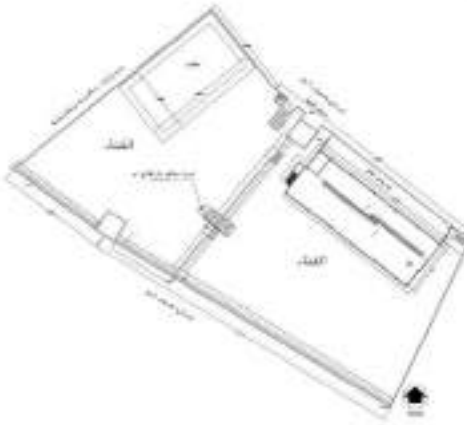
ENC1 Typical Classroom

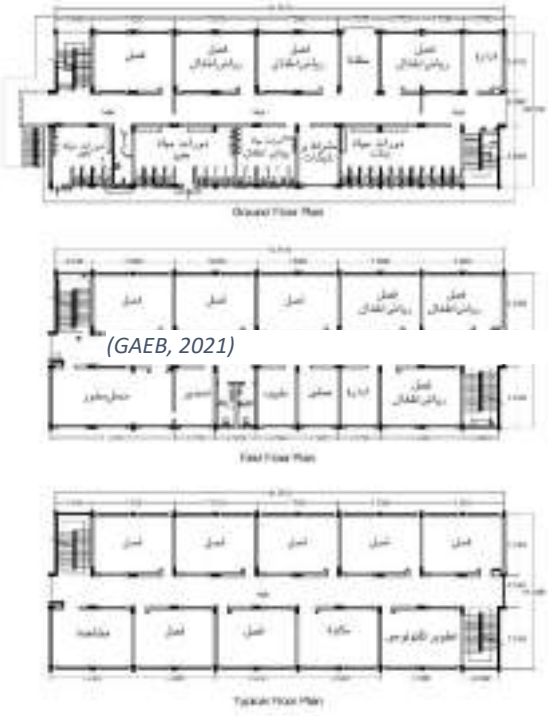
ENC1 School Corridor with iron gates to

ENC1 School Yard

ENC1 Arcaded seating area for students

Appendix C – Arabic School: BD2





(GAEB, 2021)

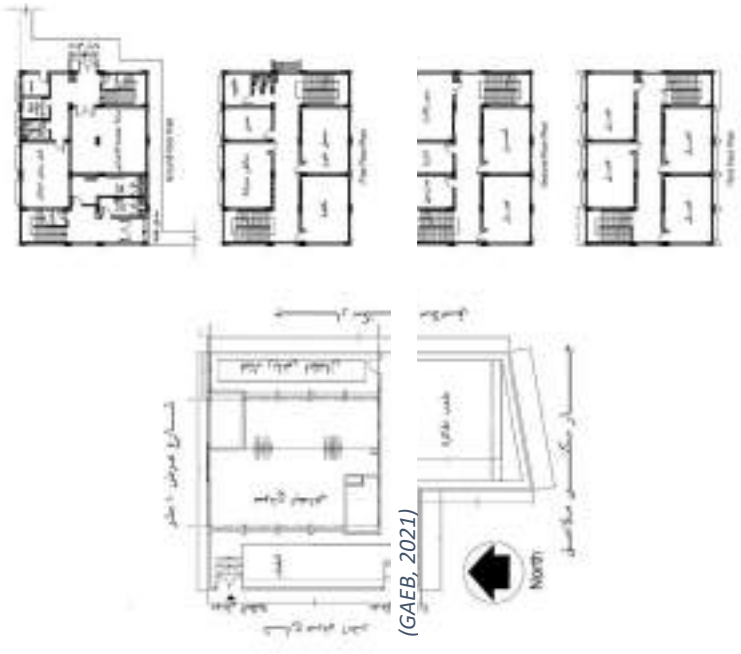
(GAEB, 2021)

BD2 Typical Classrooms

BD2 Corridor

BD2 divided School Yard serving two schools.

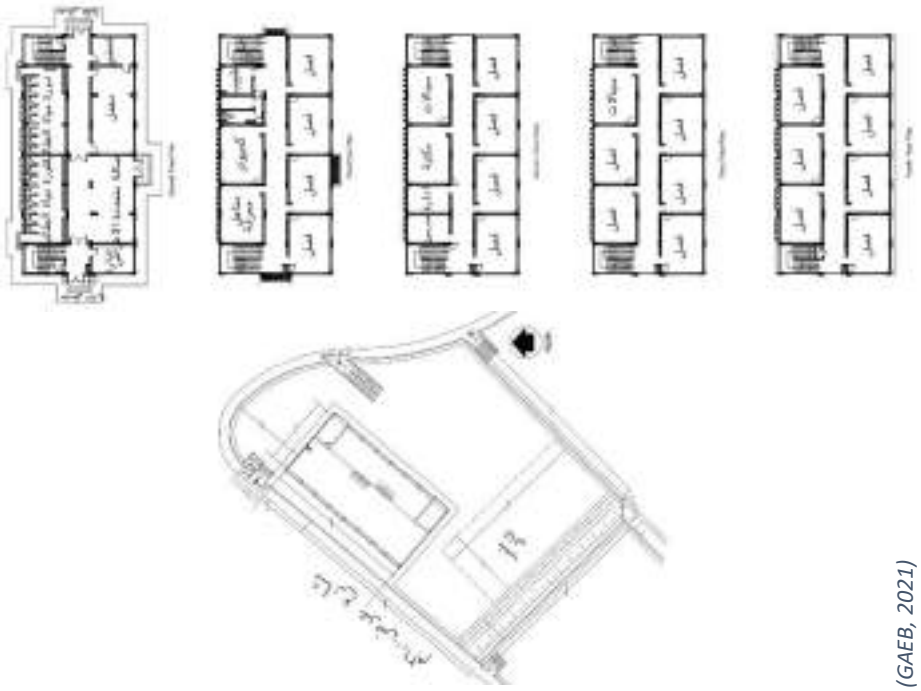
Appendix C – Arabic School: W1



(GAEB, 2021)

(GAEB, 2021)

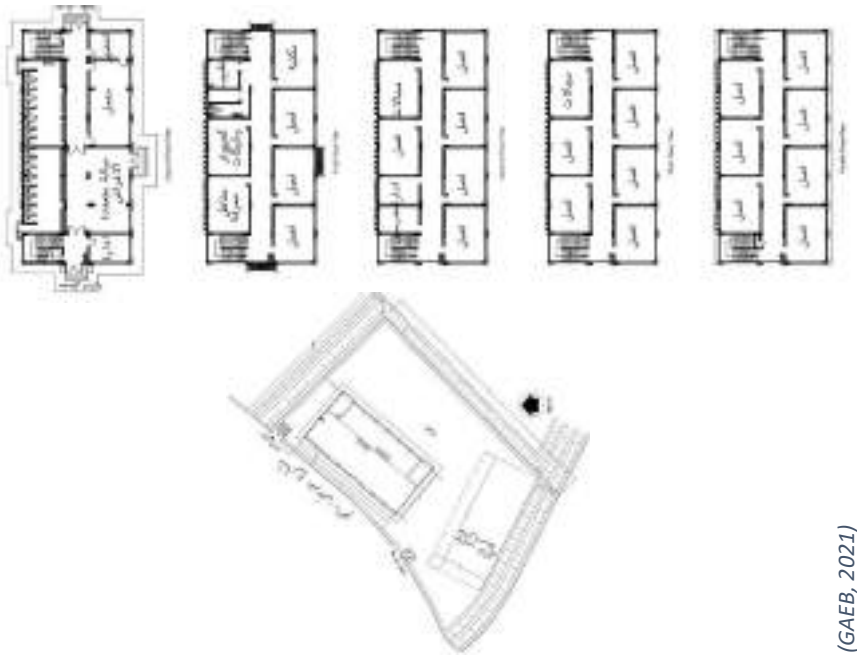
Appendix C – Arabic School: MN1



(GAEB, 2021)

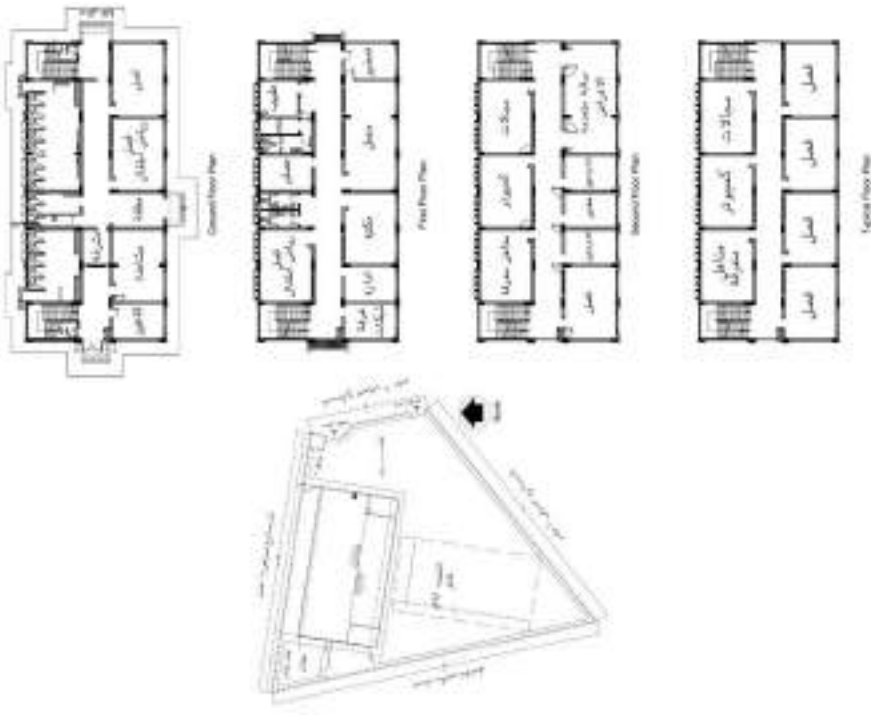
(GAEB, 2021)

Appendix C – Arabic School: MN2



(GAEB, 2021)

Appendix D – Experimental School: W2



(GAEB, 2021)

Appendix D – Experimental School: BD3

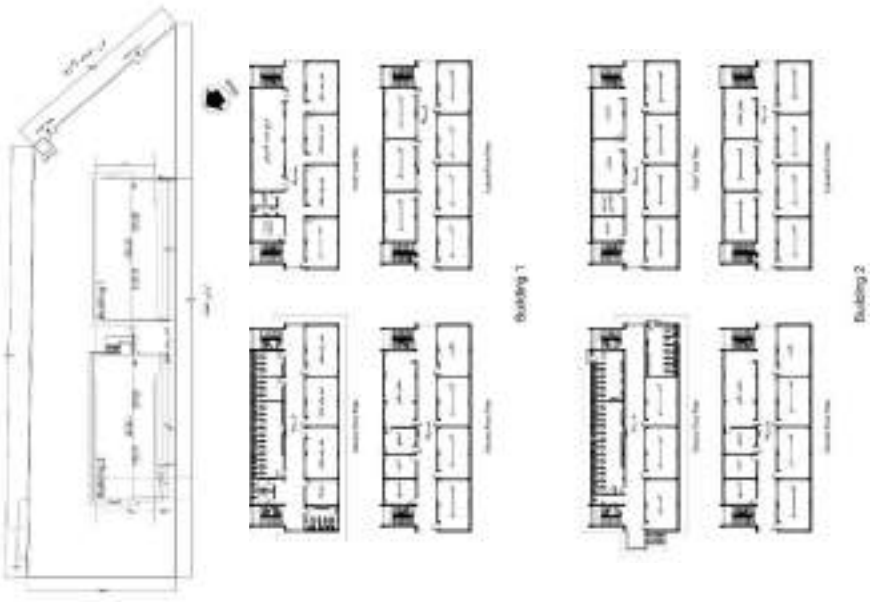
BD3 Layout (GAEB, 2021)

BD3 Typical Classroom

BD3 School Yard Facilities

BD3 Floor Plans (GAEB, 2021)

Appendix D – Experimental School: M2



(GAEB, 2021)

Appendix E – Distinctive School: ENC4

ENC4 School layout (GAEB, 2021)

ENC4 Floor Plans (GAEB, 2021)

ENC4 northern elevation and outdoor spaces

ENC4 Classroom

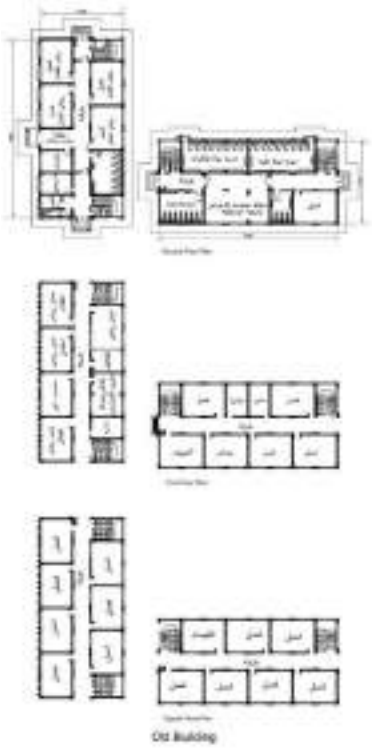
ENC4 Corridor, Library and Fields classroom

Appendix F – Future School: W3

(GAEB, 2021)

Appendix F – Future School: M3

M3 School Layout (GAEB, 2021)



M3 Old Building Floor Plans (GAEB,

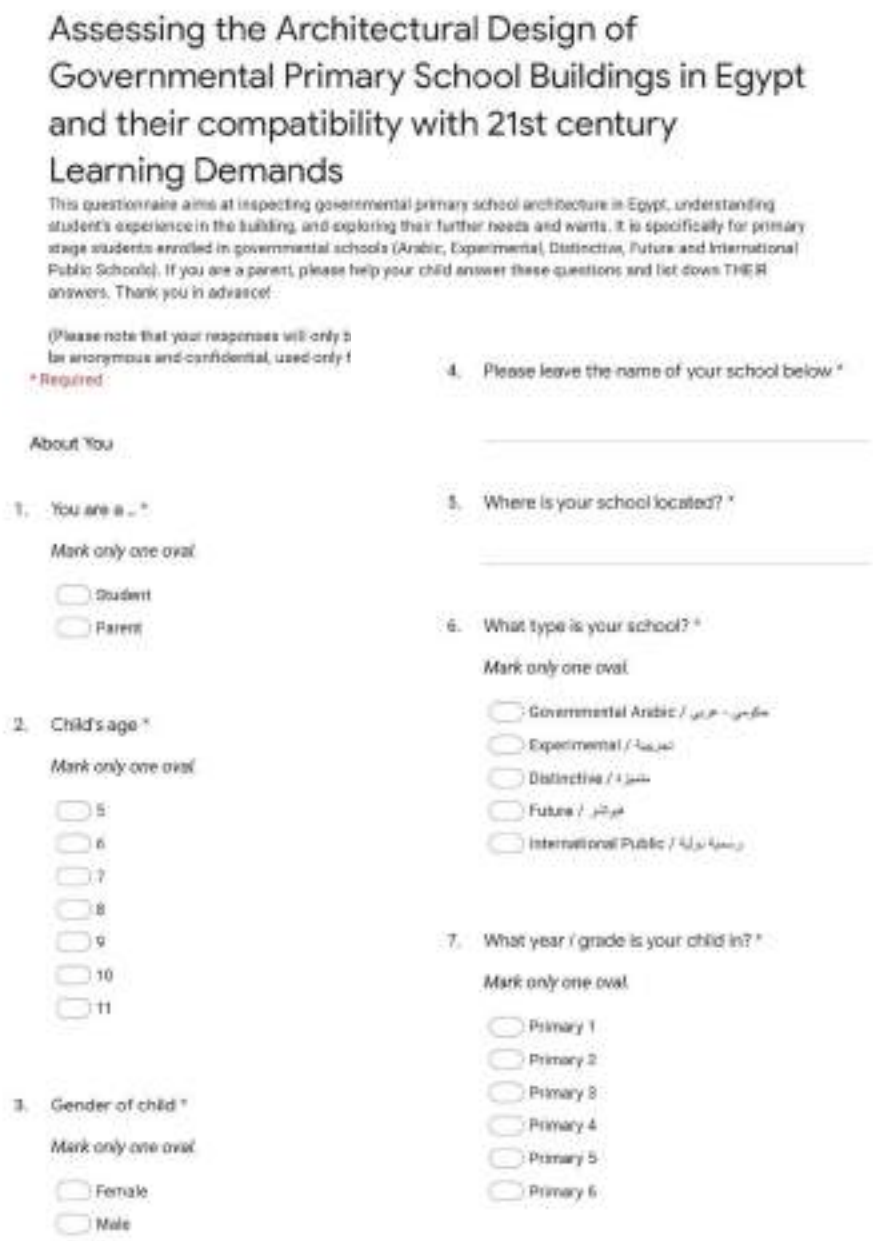
M3 New Building Floor Plans (GAEB, 2021)

M3 School Buildings

M3 New Building (Classroom, Corridor, Staircase)

M3 Green football field

Appendix G – Questionnaire 1: Students and Parents



Assessing the Architectural Design of Governmental Primary School Buildings in Egypt and their compatibility with 21st century Learning Demands

This questionnaire aims at inspecting governmental primary school architecture in Egypt, understanding student's experience in the building, and exploring their further needs and wants. It is specifically for primary stage students enrolled in governmental schools (Arabic, Experimental, Distinctive, Future and International Public Schools). If you are a parent, please help your child answer these questions and list down THEIR answers. Thank you in advance!

(Please note that your responses will only b
be anonymous and confidential, used only f
* Required

About You

1. You are a .. *

Mark only one oval

- Student
- Parent

2. Child's age *

Mark only one oval

- 5
- 6
- 7
- 8
- 9
- 10
- 11

3. Gender of child *

Mark only one oval

- Female
- Male

4. Please leave the name of your school below *

5. Where is your school located? *

6. What type is your school? *

Mark only one oval

- Governmental Arabic / حكومي - عربي
- Experimental / تجريبية
- Distinctive / متميز
- Future / فيوتشر
- International Public / رسمية دولية

7. What year / grade is your child in? *

Mark only one oval

- Primary 1
- Primary 2
- Primary 3
- Primary 4
- Primary 5
- Primary 6

Appendices

About your school

8. Which of the following spaces are available in your school? (Please select all that apply) *

Check all that apply

- [ ] A traditional classroom
- [ ] A traditional classroom with direct access to a space for individual/group work or projects
- [ ] A space for collaborative learning (2 or more classes coming together)
- [ ] A learning space in a corridor outside the classroom
- [ ] A library
- [ ] A canteen
- [ ] A science lab
- [ ] Art or Music classroom
- [ ] Fields (Agriculture - Maintenance - Home economics) classroom
- [ ] A hall / auditorium / theatre
- [ ] A workshop space for technology (wood-metal-plastics-robotics)
- [ ] A video / multimedia room
- [ ] A computer lab
- [ ] A gym

Other: [ ] _____

9. Do you take any lessons outside your classroom? *

Mark only one oval

- ( ) Yes
- ( ) No

10. If yes, please select which spaces you use from the following.

Check all that apply

- [ ] A traditional classroom
- [ ] A traditional classroom with direct access to a space for individual/group work or projects
- [ ] A space for collaborative learning (2 or more classes coming together)
- [ ] A learning space in a corridor outside the classroom
- [ ] A library
- [ ] A science lab
- [ ] Art or Music classroom
- [ ] Fields (Agriculture - Maintenance - Home economics) classroom
- [ ] A hall / auditorium / theatre
- [ ] A workshop space for technology (wood-metal-plastics-robotics)
- [ ] A video / multimedia room
- [ ] A computer lab
- [ ] A gym

11. Which of the following outdoor spaces are available in your school? *

Check all that apply

- [ ] An outdoor classroom
- [ ] Tiled court
- [ ] Sand school yard
- [ ] Playground equipment
- [ ] Grass football field
- [ ] Stepped seating area
- [ ] Benches
- [ ] Shaded seating area
- [ ] Grass (Green Area)
- [ ] Trees or flowers
- [ ] Canteen

Other: [ ] _____

Appendices

12. How many children are there in your classroom? *

13. How many children sit in one desk? *

14. Do you have a space in your school where you can study individually or in a group outside lesson time? *

Mark only one oval.

- Yes
- No

15. In your classroom, how are you normally seated? *

Mark only one oval.

Linear seating

Group seating

U-shape seating

Mixed seating

16. What do you have in your classroom? *

Check all that apply.

- Benches and desks
- Teacher's desk
- Blackboard or White board
- Smart board
- Fan or AC
- TV Screen
- Projector
- Art or Reading Area
- Posters or your work hung on the walls

Other:

Your school experience

Appendices

17. Please select the classroom that resembles yours most from the pictures below *

Mark only one oval.


Class 1


Class 2


Class 3


Class 4


Class 5

18. Please select the corridor that resembles yours most from the pictures below *

Mark only one oval.


Corridor 1


Corridor 2


Corridor 3

19. How do you feel inside your classroom? *

Mark only one oval.


Happy


Excited


Focused


Distracted


Sleepy


Bored


Comfortable


Uncomfortable

Other:

20. Rate these qualities in your classroom (Please select one response per row) *

Mark only one oval per row.

	Poor	Fair	Good	Very good	Excellent	N/A
The furniture						
The colors						
The light						
The temperature						
Number of people						
View of the outside						
Using technology (Computer-projector-smart board-TV Screen)						
Ability to move around						
Ability to choose where I want to work						
Ability to work in a group with my friends						

21. What is your favorite space in your school? Why?

22. What is your least favorite space in your school? Why?

23. Are you allowed to move inside your classroom? *

Mark only one oval.

- Yes
- No

24. How often do you use technology while learning? *

Mark only one oval.

- Always
- Sometimes
- Never

Appendices

27. Which classroom would enhance Collaboration? *

Check all that apply


Linear seating


Group seating


U-shape seating


Mixed seating

28. Which classroom would enhance Communication? *

Check all that apply


Linear seating


Group seating


U-shape seating


Mixed seating

29. Which classroom would enhance Critical thinking? *

Check all that apply


Linear seating


Group seating


U-shape seating


Mixed seating

30. Which classroom would enhance Creativity? *

Check all that apply


Linear seating


Group seating


U-shape seating


Mixed seating

IMAGINE!

31. If you could name your classroom, what would you call it?

Appendices

32. Select 3 things you want to add to your classroom. *

Check all that apply.

Group tables

Colorful furniture

White boards for kids

Art nook

Reading corner

Lockers

TV Screen

Computers and Internet

33. How would you like to sit in class? *

Mark only one oval.

Linear seating

Group seating

U shape seating

Mixed seating

34. What would you like to see more inside your classroom? *

Check all that apply.

- Trees
- Grass
- Playground or School Yard
- Activity spaces such as Art, etc.
- Another classroom
- Other children learning

Other:

35. Would you prefer learning all subjects in the same class or moving to different classes for different subjects? *

Mark only one oval.

- Same class
- Different classes

36. Select 3 things you want to add to your playground. *

Check all that apply.

Playground equipment

Grass area

Planting area

Trees and flowers

Stepped seating area

Shaded seating area

Sports field

Outdoor classroom

Appendices

37. What would make you happy and excited to go to school?

Parents only

38. Do you think the school building with all its components helps in developing your child's skills and discovering their talents? *

Mark only one oval.

- Yes
- No

39. In your opinion, what are the changes required in the school for your child to gain better education? *

Thank you for taking the time to complete this survey.

Appendix H – Questionnaire 2: Teachers

Assessing the Architectural Design of Governmental Primary School Buildings in Egypt and their compatibility with 21st century Learning Demands

This questionnaire aims at inspecting governmental primary school architecture in Egypt, understanding teachers' experience in the building, and exploring their further needs and wants. It is specifically for teachers of the primary stage in governmental schools (Arabic, Experimental, Distinctive, Future and International Public Schools). Thank you in advance!

(Please note that your responses will only be used for aca be anonymous and confidential, used only for analysis.)

* Required

About You

1. Gender *

Mark only one oval

- Male
- Female

2. How old are you? *

Mark only one oval

- Below 25
- 26-35
- 36-45
- 46-55
- 56-65
- Above 66

3. How many years of experience do you have? *

4. What subject do you teach? *

5. What year / grade do you teach? *

Check all that apply

- Primary 1
- Primary 2
- Primary 3
- Primary 4
- Primary 5
- Primary 6

6. Please leave the name of your school below *

7. Where is your school located? *

8. What type is your school? *

Mark only one oval

- Governmental Arabic
- Experimental
- Distinctive
- Future
- International Public

About your school

Appendices

9. Which of the following spaces are available in your school? (Please select all that apply) *

Check all that apply.

- [ ] A traditional classroom
- [ ] A traditional classroom with direct access to a space for individual/group work or projects
- [ ] A space for collaborative learning (2 or more classes coming together)
- [ ] A learning space in a corridor outside the classroom
- [ ] A library
- [ ] A canteen
- [ ] A science lab
- [ ] Art or Music classroom
- [ ] Fields (Agriculture - Maintenance - Home economics) classroom
- [ ] A hall / auditorium / theatre
- [ ] A workshop space for technology (wood-metal-plastics-robotics)
- [ ] A video / multimedia room
- [ ] A computer lab
- [ ] A gym

Other: [ ] _____

10. Do you teach any lessons outside your classroom? *

Mark only one oval.

- ( ) Yes
- ( ) No

11. If yes, please select which spaces you use from the following.

Check all that apply.

- [ ] A traditional classroom
- [ ] A traditional classroom with direct access to a space for individual/group work or projects
- [ ] A space for collaborative learning (2 or more classes coming together)
- [ ] A learning space in a corridor outside the classroom
- [ ] A library
- [ ] A science lab
- [ ] Art or Music classroom
- [ ] Fields (Agriculture - Maintenance - Home economics) classroom
- [ ] A hall / auditorium / theatre
- [ ] A workshop space for technology (wood-metal-plastics-robotics)
- [ ] A video / multimedia room
- [ ] A computer lab
- [ ] A gym
- [ ] School playground

12. How are learning spaces used in your school? *

Mark only one oval.

- ( ) The same learning space is used for all subjects
- ( ) I use the same learning space for a given subject for at least a semester (Room 1 for Subject A, Room 2 for Subject B , etc)
- ( ) I use many different learning spaces for my subject

Appendices

13. In a typical semester, approximately how often do you teach in the following? *

Mark only one oval per row.

	Never	Occasionally	Frequently	Always	N/A
A traditional classroom					
A traditional classroom with direct access to a space for individual/group work or projects					
A space for collaborative learning (2 or more classes coming together)					
A learning space in a corridor outside the classroom					
A library					
A science lab					
Art or Music classroom					
Fields (Agriculture - Maintenance - Home economics) classroom					
A hall / auditorium / theatre					
A workshop space for technology (wood-metal-plastics-robotics)					
A video / multimedia room					
A computer lab					
A gym					
Outdoor classroom					
School playground					

14. How satisfied are you with the availability of: *

Mark only one oval per row.

	Dissatisfied	Neutral	Satisfied	N/A
A quiet space for you to work in the school before and after lessons				
Spaces that staff can use for socializing				
Meeting rooms				
Service spaces for staff (Kitchen, lunch room...etc)				

15. To what extent do you think the buildings and facilities at your school have an impact on the following: *

Mark only one oval per row.

	Not at all	Very little	To some extent	A lot
Making you want to stay (employed) at this school				
Making others want to stay (employed) at this school				
Make it easier to attract new teachers				
Attract parents to put their children in this school				

Appendices

16. In your classroom, how are the students normally seated? *

Mark only one oval.

Linear seating

Group seating

U-shape seating

Mixed seating

17. How many children are there in your classroom? *

19. What do you have in your classroom? *

Check all that apply.

- Benches and desks
- Teacher's desk
- Blackboard or White board
- Smart board
- Fan or AC
- TV Screen
- Projector
- Art or Reading Area
- Posters or your work hung on the walls

Other:

20. Do you have a space in your school where students can study individually or in a group outside lesson time? *

Mark only one oval.

- Yes
- No

Appendices

Your school experience

21. Please select the classroom that resembles yours most from the pictures below *

Mark only one oval.

Class 1

Class 2

Class 3

Class 4

Class 5

22. Please select the corridor that resembles yours most from the pictures below *

Mark only one oval.

Corridor 1

Corridor 2

Corridor 3

23. Rate these qualities in your classroom (Please select one response per row) *

Mark only one oval per row.

	Poor	Fair	Good	Very good	Excellent	N/A
The furniture						
The colors						
The light						
The temperature						
Number of people						
View of the outside						
Using technology (Computer projector smart board-TV Screen)						
Ability of students to move around						
Ability of students to choose where they want to work						
Ability of students to work in groups						

Appendices

24. How often do you use technology while teaching? *

Mark only one oval.

- Always
- Sometimes
- Never

25. How often do you need to change the classroom furniture setting for your lessons or planned activities? *

Mark only one oval.

- Never
- Sometimes
- Often
- Always
- Other: _____

26. Are students allowed to move inside your classroom? *

Mark only one oval.

- Yes
- No

27. Which classroom would enhance Collaboration? *

28. Which classroom would enhance Communication? *

Appendices

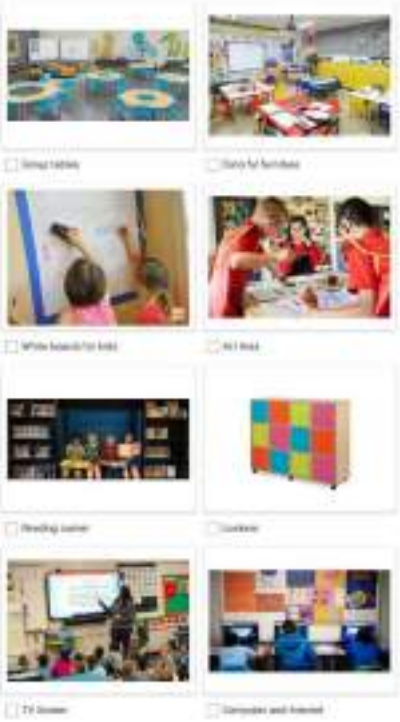
29. Which classroom would enhance Critical thinking? *

30. Which classroom would enhance Creativity? *

33. How would you prefer the students to sit in class? *

Mark only one oval.

34. Select 3 things you could add to your classroom for a better learning outcome with students *



Appendices

36. Do you think the school building with all its components helps in developing children's skills and discovering their talents? *

Mark only one oval.

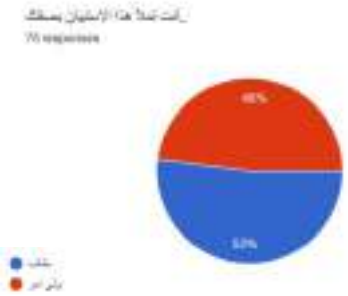
- Yes
- No

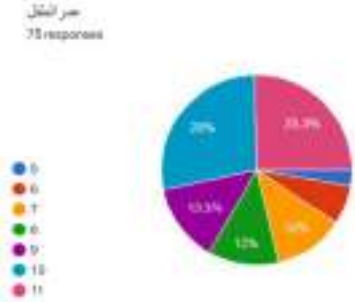
37. What would make your job easier and more enjoyable? *

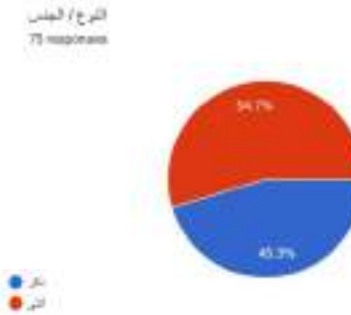
38. In your opinion, what are the changes required in the school for better education? *

Thank you for taking the time to complete this survey.

Appendix I – Questionnaire 1: Students and Parents – Responses







اكتب اسم مدرستك على السطر التالي
الترجمة الرسمية للغات
Class
صبر ابن الخطاب الإبتدائية
العمران الحديثة
مدرسة الخصوص التجريبية
صبر ابن الخطاب الرسمية للغات
ملجأة دار المعلمين بستاتل سليم
صبر بن الخطاب الرسمية للغات
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الجيل الجديد
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هناك ابن الوليد المشتركة ١
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حافظ ابراهيم
المنيرة ب
هناك ابن الوليد المشتركة ١
المنيرة ب
الخصوص الجديدة
المنيرة ١
المنيرة ب
المنيرة
التوحيد
مدرسة حرية ٣ الإبتدائية
المعهد المتميز بالمنيرة
طارق بن زياد
بهجة
مدرسة الشهيد الحسيني المخروقي
محمد نجيب الإبتدائية
SOVA international school
محمد نجيب
مدرسة الحرية
النور الأخضر الإبتدائية

محمد نجيب الابتدائية
محمد نجيب الابتدائية
حافظة ابراهيم الابتدائية
خديجة ام المؤمنين
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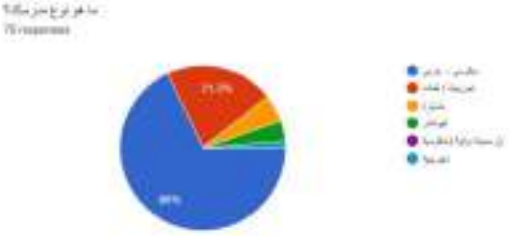
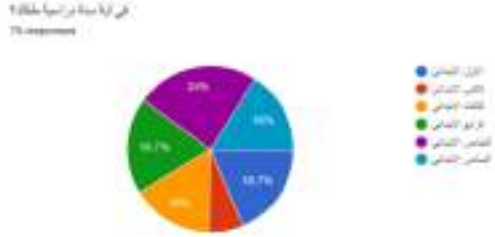
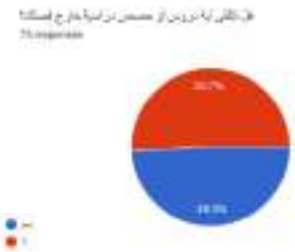
الشهيد أيهاب درسي التجريبي
الحلفاء الراشدين
الحلفاء الراشدين
قاسم امين الرسمية المتميزة للغات بنات
نجيب الدافعة الرسمية للغات
مدرسة سعيد موسى الرسمية للغات
فرع بالتجريبي
براعم المستقبل
جيل جديد
عمر مكرم
عمر ابن الخطاب
الهلال
البيجا الإبتدائية الحديثة
مدرسة التعريبي للغات
ملائم المستقبل للغات
الوادي
التميمي الإبتدائية المشتركة
المغربي
الشيخ زايد الرسمية الجي الأول
هورس للغات
ملجأة دار المعلمين
مدرسة رسميس الخاصة للغات

Appendices


المنطقة التي تقع فيها مدرستك
75 responses
10.0
7.5
5.0
2.5
0.0
10 (13.3%)
7 (9.3%)
4 (5.3%)
4 (5.3%)
3 (4%)
2 (2.7%)
2 (2.7%)
2 (2.7%)
2 (2.7%)
2 (2.7%)
دارة الزهاة
الجوزا
...الخصوص بمحافظه الق
المربع
السلك
امداية
طوران
ساحل سليم اسفوط
شرا الخيمه
عزبه النخل الشرقية
كفر الدوار بحيره
بطلات

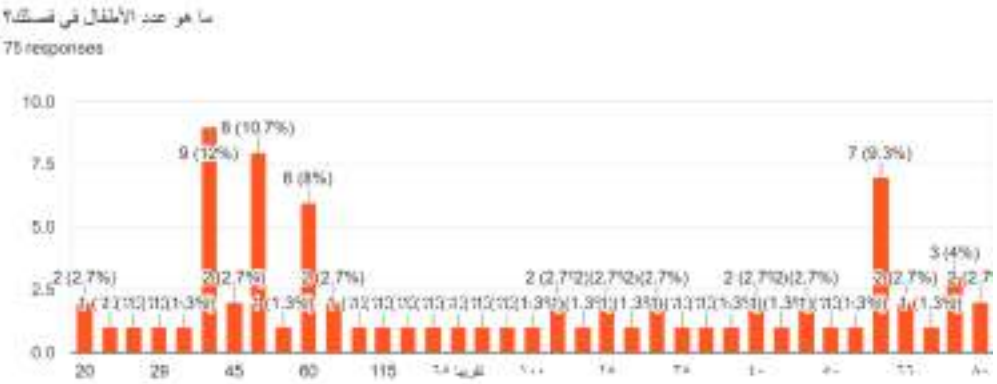


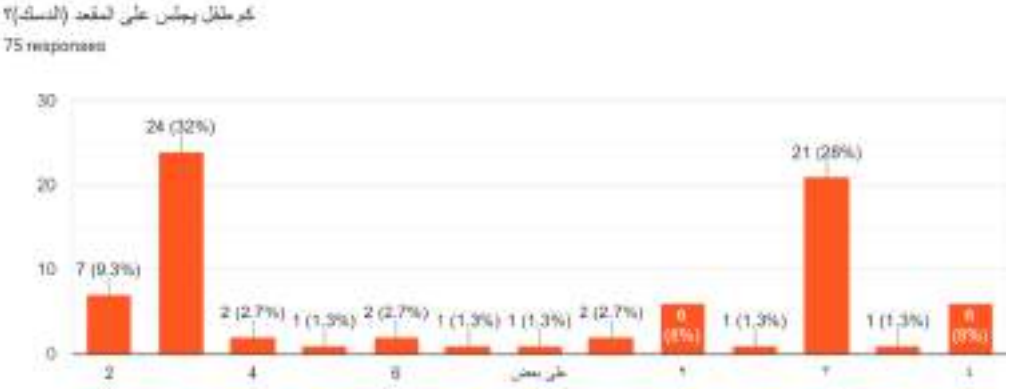




Appendices


أي من الفراغات الخارجية التالية موجودة في منزلك؟
75 responses
25 (33.3%)
37 (49.3%)
33 (44%)
15 (20%)
9 (12%)
17 (22.7%)
23 (30.7%)
16 (21.3%)
7 (9.3%)
24 (32%)
44 (58.7%)
0
10
20
30
40
50


ما هو عدد الأطفال في فصلك؟
75 responses
10.0
7.5
5.0
2.5
0.0
6 (10.7%)
9 (12%)
8 (8%)
7 (9.3%)
3 (4%)
2 (2.7%)
20
45
60
115


كم طفل يجلس على المقعد (الدسك)؟
75 responses
30
20
10
0
24 (32%)
21 (28%)
7 (9.3%)
2 (2.7%)
1 (1.3%)
2 (2.7%)
1 (1.3%)
1 (1.3%)
2 (2.7%)
1 (1.3%)
1 (1.3%)
2
4
6
أكثر من

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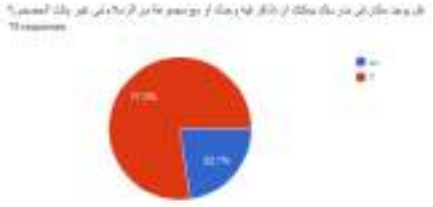

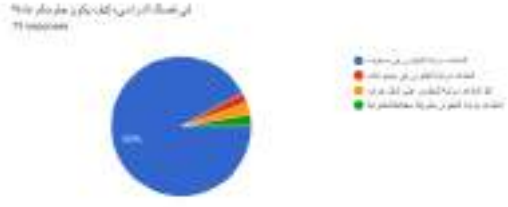

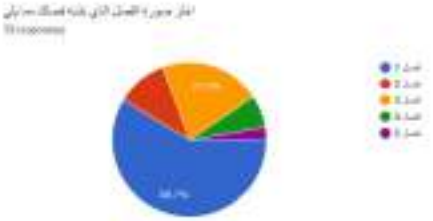

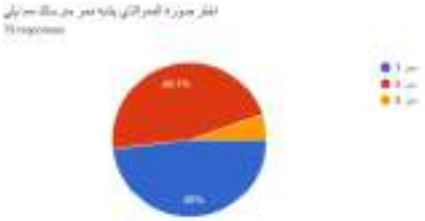

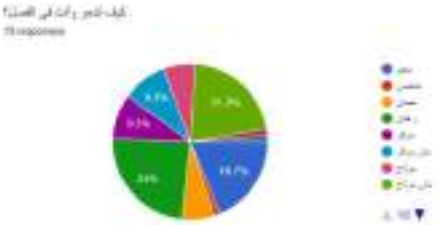

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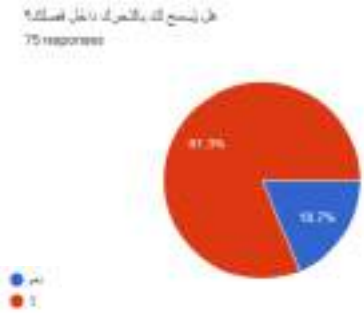
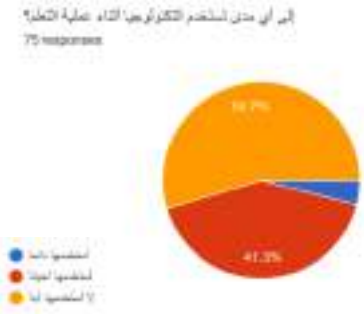
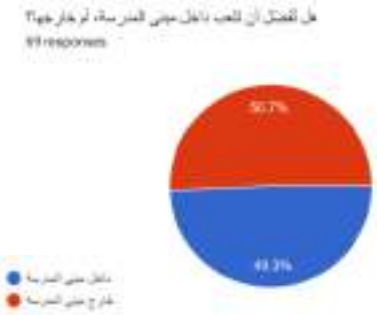
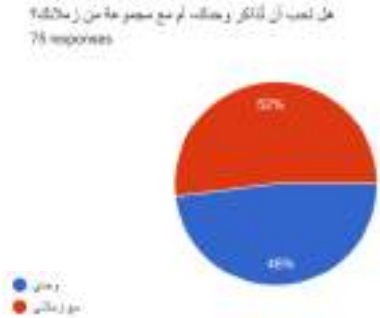
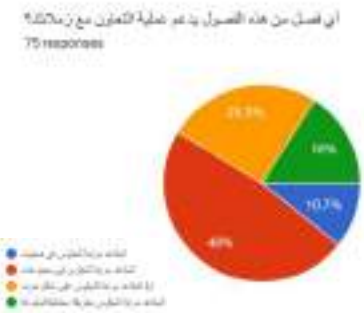
Appendices

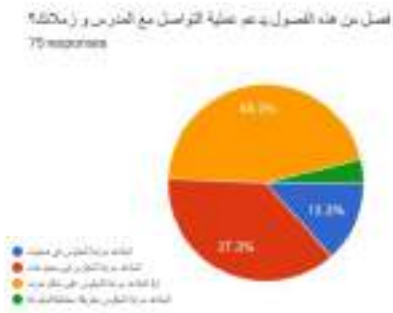

هل يسمح لك بالتحرك داخل فصلك؟
75 responses
41.3%
58.7%
نعم
لا

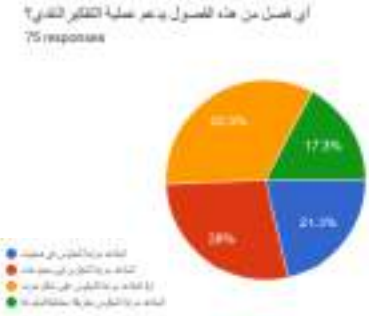

إلى أي مدى تستخدم التكنولوجيا أثناء عملية التعلم؟
75 responses
58.7%
41.3%

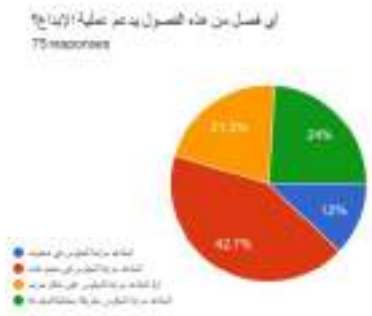

هل تفضل أن تلعب داخل مبنى المدرسة، أم خارجها؟
69 responses
50.7%
49.3%
داخل مبنى المدرسة
خارج مبنى المدرسة


هل تحب أن تذاكر وحدك، أم مع مجموعة من زملائك؟
75 responses
52%
48%
وحدي
مع زملائي

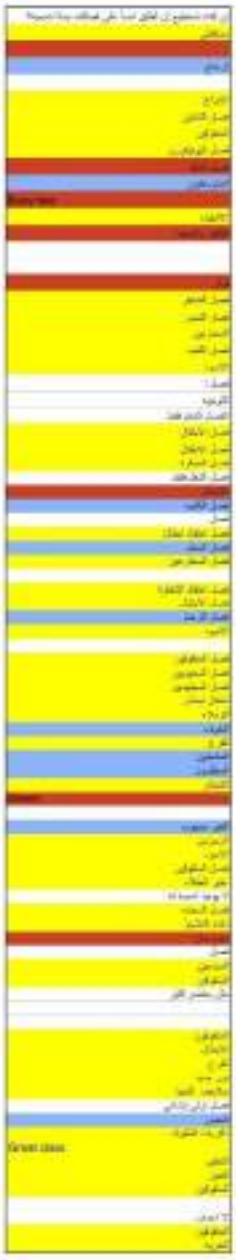

أي فصل من هذه الفصول يدعم عملية التعاون مع زملائك؟
75 responses
10.7%
40%


أي فصل من هذه الفصول يدعم عملية التواصل مع المدرس و زملائك؟
75 responses
37.3%

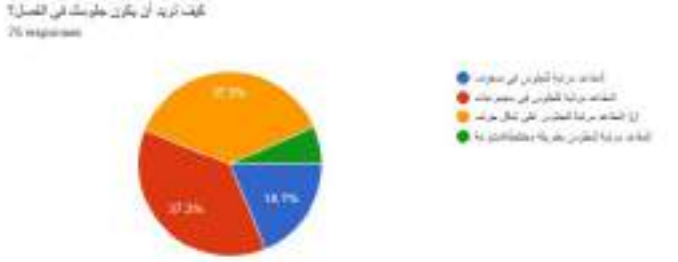

أي فصل من هذه الفصول يدعم عملية التفكير النقدي؟
75 responses
17.3%
21.3%
28%

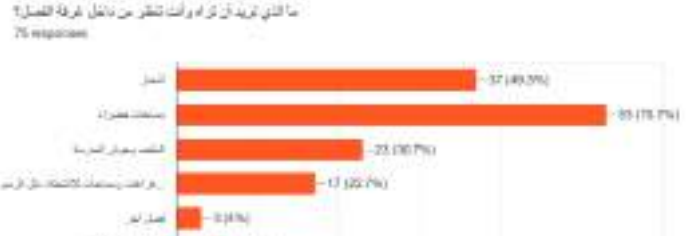

أي فصل من هذه الفصول يدعم عملية الإبداع؟
75 responses
24%
12%
42.7%

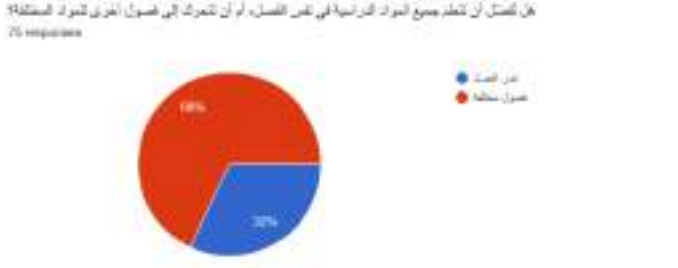
Appendices




اختر 3 أشياء مما يلي تريد أن تضيفها إلى فصلك
76 responses
34 (45.3%)
27 (36%)
14 (18.7%)
45 (60%)
17 (22.7%)
30 (40%)
29 (38.7%)
29 (38.7%)
0
10
20
30
40
50


كيف تريد أن يكون جلوسك في الفصل؟
76 responses
37.3%
18.7%
37.3%


ما الذي تريد أن تراه وأنت تنظر من داخل غرفة الفصل؟
76 responses
57 (49.5%)
55 (75.7%)
23 (30.7%)
17 (22.7%)
3 (4%)


هل تفضل أن تنظم جميع المواد الدراسية في نفس الفصل، أم أن تتحرك إلى فصول أخرى للمواد المختلفة؟
76 responses
68%
32%

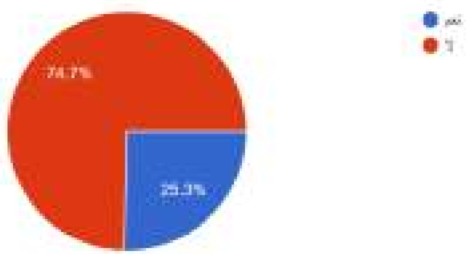
Appendices

School facilities	Social aspect	Learning and organization	Activities	Learning with friends	Leisure	[illegible]	Money	N/A
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]			
[illegible]		[illegible]	[illegible]		[illegible]			
[illegible]		[illegible]	[illegible]					
[illegible]			[illegible]					
[illegible]			[illegible]					
[illegible]			[illegible]					
[illegible]			[illegible]					
[illegible]			[illegible]					
			[illegible]					
13	6	8	14	4	7	4	1	18
0.23%	0.11%	0.14%	0.25%	0.07%	0.12%	0.07%	0.02%	0.32%

Activities	[illegible]
School facilities	[illegible]
Learning and organization	0.14%
Leisure	0.12%
Social aspect	0.11%

هل تعتقد أن مبنى المدرسة بكل أجزائه يساعد على تنمية مهارات طفلك واكتشاف مواهبه؟

75 responses



اختر 3 أشياء مما يلي تريد أن تضيفها إلى حوش المدرسة

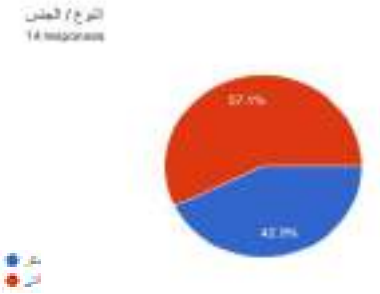
75 responses

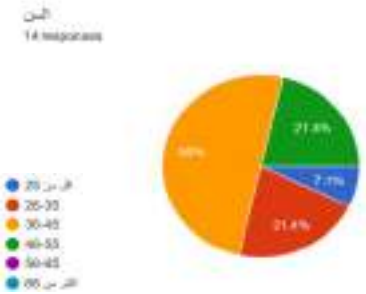
Appendices

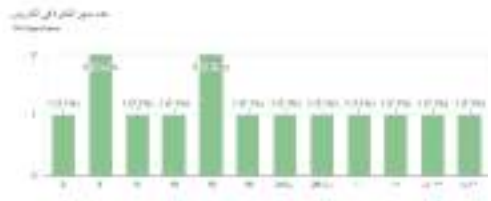
Nurturing the children and developing their talents	School facilities	Learning and organization	Decreasing classroom capacities	[illegible]	N/A
اعطاء الطفل مساحة للابداع والابتكار	الوان الفصول و التهوية و الإضاءة و التكنولوجيا في الفصول	المعلم يكون لديه المساواة مع الطلاب ويكون لديه تميز في الشرح ويكون لديه اسلوب جذاب لإلقاء المعلومات	اعداد الفصول اقل	[illegible]	
توفير وقت لإبداع الأطفال	التصميم المعماري + الإدارة المدرسية المكونة	تغيير طريقة التدريس	مراعاة عدد الأطفال في الفصل الواحد وجود مساحة ولو بسيطة للطفل لاكتشاف ميوله واحتياجاته الفصول في المدرسة صغيرة جدا جدا جدا لدرجة ان الأطفال غير قادرين على الحركة داخل الفصل		
تغيير ثقافة التعليم في المدرسة	الوان مبهجة مساحات خارجية اكثر مسرح	طريقة التعليم مش حلوة	تقليل الأعداد في الفصل مع اختيار مدرسين اكفاء		
اماكن تنمي مهارات الطفل	المدرسة قديمة جدا محتاجة تجديد وتوسعات فهي صغيرة	وقت اضافي	ان يتم تحديد الفصول الدراسية بصفة مستمرة وان يكون عدد الأطفال بالفصل لا يزيد عن ٢٢ طفل وان يكون المدرسين على كفاءة تامة في التعامل مع الأطفال والمستوى العلمي		
الاهتمام بالابداع والابتكار	الفصل ملون الوان حلوة خضرة في الشكل العام كمبيوتر داخل الفصل	تغيير المدرسين			
الاهتمام بالأطفال وتنمية مهاراتهم	توفر التكنولوجيا زيادة المساحات الخضراء	طريقة التدريس			
العاب رياضية واعمال يدوية وبعض الترفيه والتركيز في التعليم اكثر من كده	غرف انشطة	نظام المدرسة والمدرس			
الاهتمام بالفنون والابداع الاهتمام بالابداع والابتكار	معامل للتطبيق العملي وجود تكنولوجيا واماكن ترفيهية	الشرح يكون كويس التعليم يكون افضل			
الاهتمام بالإبداع والابتكار	شاشات الكترونية واضافة التعليم عن طريق الانترنت	الرقابة على المعلمين والمعلمات			
الاهتمام بالأطفال والإبداع	فصول مختلفة ومجهزة للتعليم بطرق حديثة والأعداد تكون قليلة	تحسين المستوى الفكري للمدرسين والهيئة التدريسية			
الاهتمام بالإبداع	طريقة التعامل و اشكال الفصل والفناء	معاملة المدرسين مع التلاميذ واحترامهم			
التعاون	تغيير المقاعد	تغيير المناهج وطريقة تقديمها			
بالإبداع والابتكار	مساحات للتحرك بحرية فصول مريحة نفسيا للأطفال	هو مناسب اسلوب جديد			
الاهتمام بالأطفال وبتفكيرهم	تغيير شكل الفصول وتوفير مساحات خضراء	من+F2:F18 رأيي ان تهتم بطريقة التدريس لتجعل الطلاب يحبون العلم			
الاهتمام بالأطفال	انشطة اكثر و وسائل تكنولوجيا تواكب العصر خاصة في ظل الكورونا				
عمل انشطة مختلفة للأطفال توسيع الفصول تقليل عدد الطلبة داخل الفصل اهتمام بالأطفال	اضافة انشطة وتغيير الوان الفصول الشبيهة بالسجن مساحة خضراء واجهزة كمبيوتر				
عمل انشطة مختلفة	عمل قاعات للأنشطة ومعامل كمبيوتر ومعامل علوم				
التعاون	وجود اجهزة للرسم بكل انواعه واجهزة للموسيقى و ملاعب رياضية ووسائل تعليمية مختلفة				
التعاون	اماكن مفتوحة مخصصة للقراءة الرسم والفصول خارجية				
التعاون					
الاهتمام بالأطفال					
تقدير الطفل والاهتمام بمراعاة والتنوع في الطرق التعلم					
الاهتمام بعقل الطفل					
توفير كل احتياجات الطلاب					
كثرة الأنشطة وتنمية مهارات الأطفال					
الافضل والتعاون في كل شيء					
التركيز على الأنشطة الرياضية و الالتزام ان توجد انشطة متوفرة للأطفال					
تنمية مهارات الطفل والبعد عن الحفظ والتلقين					
تحديث الأنشطة واضافة الرياضة والرسم الاهتمام بموهبة الأطفال					
33 0.45%	21 0.28%	10 0.14%	4 0.05%	1 0.01%	1 0.01%

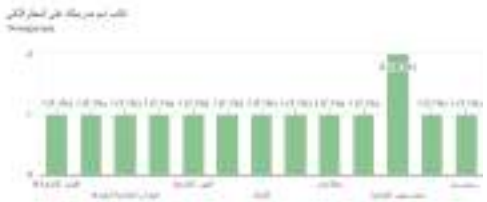
Nurturing the children and developing their talents	[illegible]
School facilities	0.28%
Learning and organization	0.14%
Decreasing classroom capacities	0.05%
[illegible]	0.01%

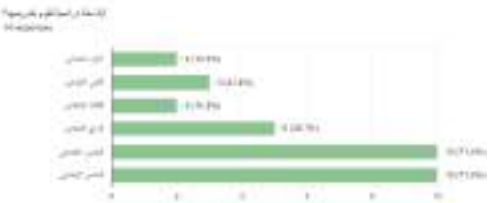
Appendix J – Questionnaire 2: Teachers – Responses

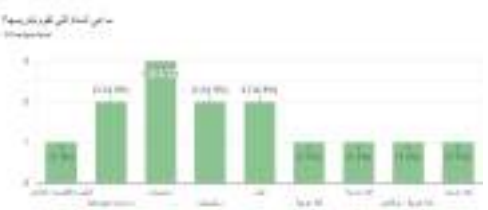


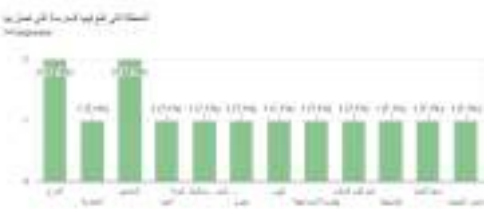


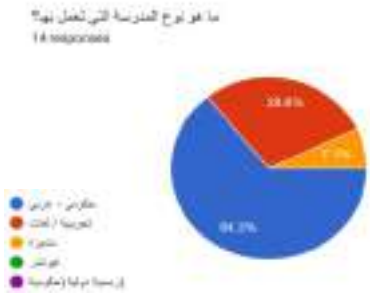






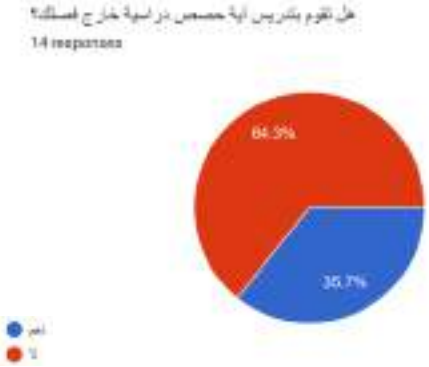




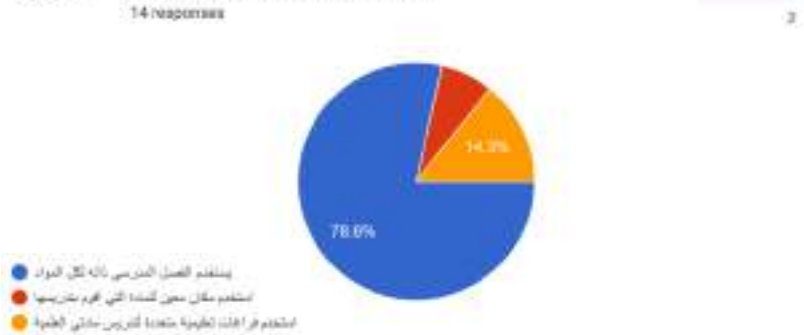


Appendices


أي من القراعات المدرسية التالية توجد في المدرسة التي تعمل بها؟ ضع علامة أمام جميع القراعات الموجودة في مدرستك.
14 responses
12 (85.7%)
3 (21.4%)
0 (0%)
1 (7.1%)
10 (71.4%)
6 (57.1%)
6 (42.9%)
5 (35.7%)
3 (21.4%)
1 (7.1%)
0 (0%)
2 (14.3%)
9 (64.3%)
0 (0%)
0.0
2.5
5.0
7.5
10.0
12.5


هل تقوم بتدريس أية حصص دراسية خارج فصلك؟
14 responses
64.3%
35.7%
نعم
لا


إن كانت إجابتك عن السؤال السابق "نعم"، أي من القراعات التالية تلزمن فيها تلك الحصص؟
4 responses
2 (50%)
0 (0%)
0 (0%)
1 (25%)
2 (50%)
0 (0%)
0 (0%)
0 (0%)
0 (0%)
2 (50%)
3


كيف يتم استخدام القراعات المدرسية بمدرستك؟
14 responses
14.3%
78.6%
يستخدم الفصل المدرسي داخله لكل المواد
استخدم مكان معين للمادة التي أقوم بتدريسها
استخدم قراءات تكنولوجية متعددة لتدريس مادتي العلمية

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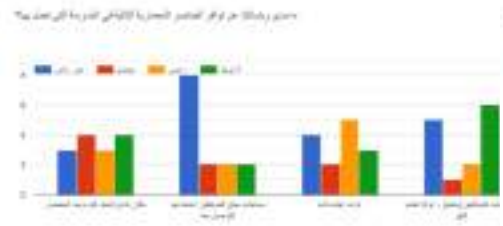

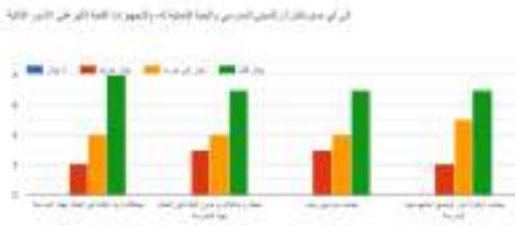

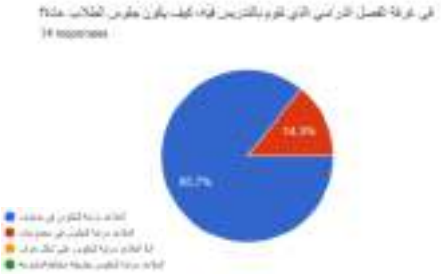

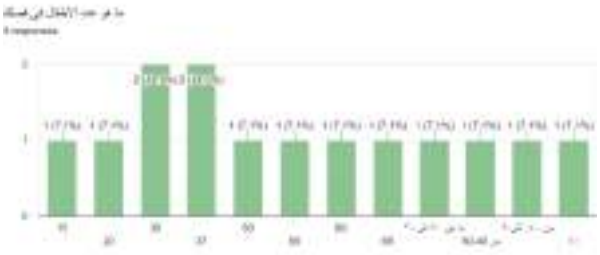

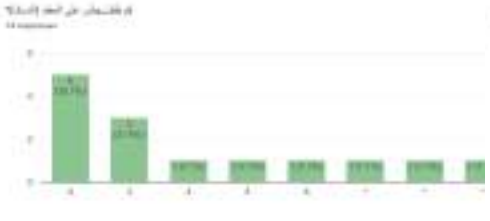

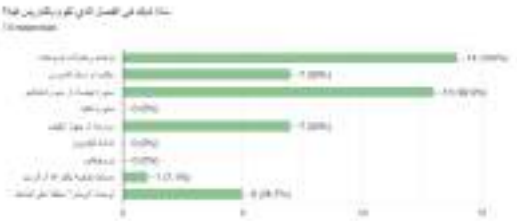

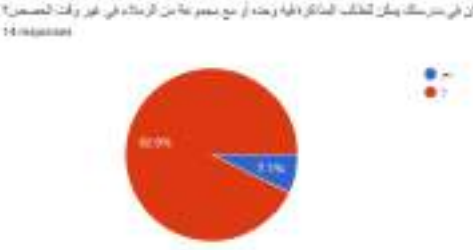

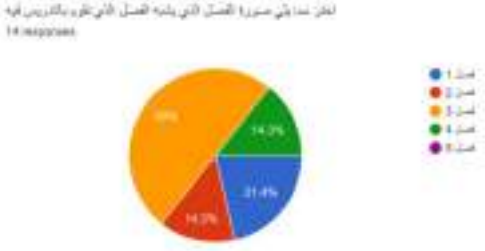

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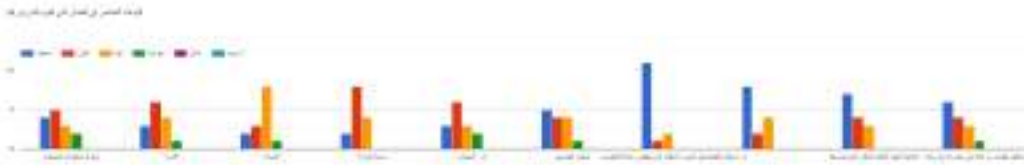

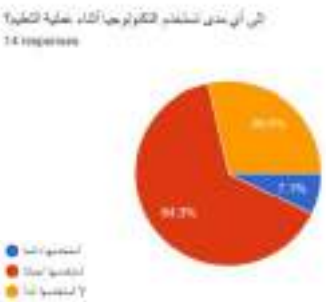

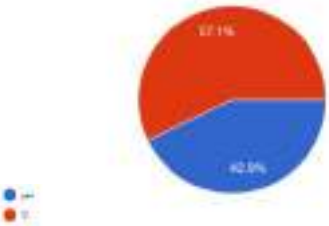

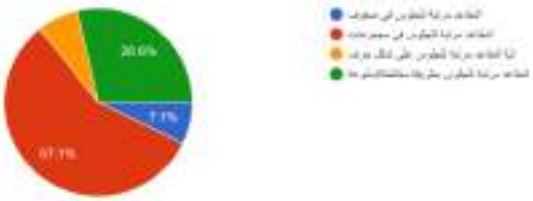

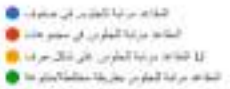

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أي فصل من هذه الفصول يدعم عملية التفكير النقدي عند الطالب؟
14 responses

أي فصل من هذه الفصول يدعم عملية الإبداع والابتكار عند الطلبة؟
14 responses

ما هي التحديات التي تواجهها عند التدريس في المدرسة التي تعمل بها؟

Classroom Capacities	School facilities	Learning and organization
كثرة عدد التلاميذ وضيق مساحة الفصل العمل داخل مجموعات داخل حجرة دراسة صغيرة و عدد كبير من التلاميذ ضعف الامكانيات مع زيادة اعداد التلاميذ حدة الطلبة وطول اليوم الزحام داخل الفصل	ضعف الامكانيات المتاحة مع تأثير المجتمع الخارجي على طلابي بشكل كبير توفير الامكانيات والوسائل التعليمية قلة الامكانيات وقلة التعامل مع التكنولوجيا اثاث محطم ، عدد التلاميذ ، ضعف الإمكانات ، ضعف التكامل بين المدرسين لتحقيق تكامل المعرفة وتحقيق تكامل النمو عند التلاميذ مكان التدريس غير مريح عدم التهوية الجيدة ، عدم وجود سبورة ذكية ، عدم وجود مكبر صوت	حب اللغه العربيه عدم قبول الطفل الدراسة ضيق وقت الحصص و قلة احترام الأولاد
5 0.36%	6 0.43%	3 0.21%

School facilities	0.43%
Classroom Capacities	0.36%
Learning and organization	0.21%

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كيف تفضل أن يجلس الطلاب في فصلك؟
14 responses
14.3%
14.3%
57.1%
14.3%


بحسب رأيك، ما الذي ينقص نظامنا التعليمي؟
School facilities
Learning and organization
الامكانيات المادية والتكنولوجية
الإمكانيات والوسائل ت
مساحات اكثر في المدارس تساعد على تنمية حب الطالب المدرسة وزيادة الانشطة حتى يصل لمرحلة انه يتمنى ان لا يخرج من المدرسة وزيادة التعامل مع التكنولوجيا بكل الصور الممكنة ويكون هناك غرف وفصول للعمل الجماعي
تطبيق النظم الحديثة في أبطار وحدود قدراتنا بشكل صحيح
وضع المعلم في مكانه الصحيح سواء بتقديره اجتماعيا ،ماديا ، نفسيا ، إعداده وتدريبه وتطوير قدراته
الالتزام
إستخدام التكنولوجيا
التواصل الفعال بين التلميذ والمدرس


حدد 3 أشياء يمكنك إضافتها إلى فصلك لتحقيق نتائج تعليمية أفضل مع الطلاب
14 responses
طاولات (ترابيزات) للمجموعات
قطع أثاث ملون
سبورات بيضاء للأطفال
مساحة خاصة للرسم
ركن للقراءة
دواليب خاصة للأطفال
شاشة للتلفزيون
كومبيوتر وانترنت
9 (64.3%)
4 (28.6%)
0 (0%)
4 (28.6%)
6 (42.9%)
4 (28.6%)
5 (35.7%)
10 (71.4%)
طاولات (ترابيزات) للمجموعات
Count: 9
0
2
4
6
8
10

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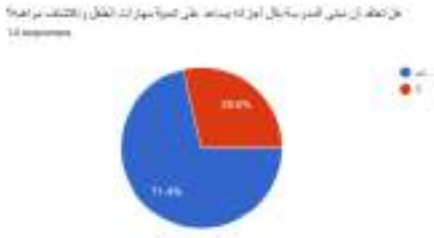

ما الذي يمكن أن يجعل صفك تحدي في هذه المدرسة أكثر فعالية وإمتاعا؟

School facilities	Learning and organization
وجود التكنولوجية الحديثة كالسبورة الذكية	رضا الطلاب على وعن المدرسة
توافد كل الإمكانيات المتاحة لعملية التعليم	الانضباط
زيادة العمل بالتكنولوجيا وتوفير اجهزة للتدريب والتعليم	التطوير في عملية التعلم
توفر الإمكانات التي تساعدني في جعل التعلم ممتعا للتلاميذ	الالتزام والاستقرار والمحتوى العلمي المناسب مع التطور التكنولوجي
أن تكون بها الإمكانيات المتاحة للتنمية الأطفال	الاهتمام بالتفكير الإبداعي
اجهزة التعامل	التواصل النشط
تجديد المدرسة كليا	الاهتمام بالمعلم
7	7
0.50%	0.50%

بحسب رأيك، ما هي التغيرات المطلوب عملها في المدرسة لتحقيق إنجاز تعليمي أفضل؟

Nurturing the children and developing their talents	School facilities	Learning and organization	Decreasing classroom capacities
عمل فصول خارجية بطريقة تسمح للتلاميذ بالمشي والزراعة والتهريب واللعب والرسم والتفكير داخل الحصة ليتعلم التلاميذ بما يناسب خصائص نموهم	أن يكون مساحة الفصل مناسبة لأعداد التلاميذ وتجديد الهم بصورة داخل الفصل لتشجيع العمل الجماعي	ادخال تكنولوجيا جديدة	قلة عدد الطلاب داخل الفصل وتوافد الوسائل التعليمية
لابد من وجود أماكن مخصصة مثل مكان الرسم أو الرياضة أو غيرها و عدم الحبس داخل الفصل طوال اليوم	الاهتمام بالفصول التعليمية وادخال بعض وسائل التعليم الحديثة مع تدريب المعلمين عليها	التعلم بالخبرة وليس بالتلقين	أجهزة معامل، تقليل عدد الطلبة للصف، وتشجيع البحث العلمي
	زيادة مساحات الملاعب المدرسية توفير فصول الفصل الجماعي	التغير في المناهج	
	تطوير الوحدات المدرسية الخاصة لماكن لإيسع داخل المدرسة وخارجها	الاهتمام بالتعليم	
	الاهتمام بالأدوات والتكنولوجيا ما أمكنت بالطبع من الصور		
2	6	4	2
0.14%	0.43%	0.29%	0.14%

School facilities	0.43%
Learning and organization	0.29%
Nurturing the children and developing their talents	0.14%
Decreasing classroom capacities	0.14%

ملخص البحث

يلعب التعليم دوراً محورياً في تطور الأمم، إذ يُعتبر الاستثمار الرئيسي في رأس المال البشري. من خلال المدارس، يتعلم الأطفال كافة المهارات التي يحتاجون إليها لتحقيق النجاح في هذا العالم المتجدد؛ ومن أجل إعداد هؤلاء الطلاب لمستقبلهم الذي لا يمكن التنبؤ به، لابد من تصميم المدارس بالأسلوب الذي يتلاءم مع متطلبات التعلم في القرن الحادي والعشرين. في مصر، مازال التعليم يتلاقى في معظمه مع متطلبات التعلم في القرن العشرين، ومازال التصميم المعماري للمدارس يسير طبقاً لمنهجية ومعايير صناعة التعليم. وبينما تتسارع التغيرات عالمياً صوب متطلبات التعلم في القرن الحادي والعشرين، ويُعاد توصيف وتصميم المدارس لتلبي تلك المتطلبات، مازالت المدارس الرسمية في مصر تواجه الكثير من أوجه القصور في مدي مواءمتها وتلبيتها لمتطلبات التعلم في القرن الحادي والعشرين.

يتمحور الهدف الرئيسي من هذا البحث حول فهم الأبعاد التاريخية التي أدت لصيرورة مباني المدارس في صورتها الحالية، والمفاهيم ومتطلبات التعلم التي خدمتها آنذاك، ومقارنة كل ذلك مع احتياجات القرن الحادي والعشرين. عندئذ، سيتم إلقاء الضوء على متطلبات التعلم في القرن الحادي والعشرين، وكيفية انعكاس ذلك في تصميم المدرسة. بعد ذلك، سوف يركز البحث على حالة المدارس الرسمية المحلية، وتحليل وتقييم مدى خدمتها وملاءمتها لمتطلبات التعلم في العصر الحاضر. أخيراً، سوف يتم عرض وتقديم بعض التوصيات ومعايير التصميم التي يمكن تبنيها وتطبيقها لكي نتيقن من أن تصميمات المدارس في مصر تتجه صوب تلبية متطلبات التعلم في القرن الحادي والعشرين.

من خلال مراجعة واستعراض الدراسات والأبحاث التي سبق نشرها، والقيام بعدد من الزيارات الميدانية لعينة عشوائية من المدارس الرسمية الخاصة بمرحلة التعليم الابتدائي، سوف يبين هذا البحث كيف أن المباني المدرسية، ونظام التعليم، يعكسان معاً خصائص وديناميات المجتمع، بهدف الوصول إلى تحديد متطلبات المجتمع في الحاضر والمستقبل، وملاقاتها في إطار التوظيف الفراغي أثناء عملية التصميم.

بواسطة استخدام الاستبيانات، وإدارة ورش التصميم التشاركي مع الأطفال، سوف يلقي هذا البحث مزيداً من الضوء حول الآراء المختلفة لمستخدمي المدارس، سعياً للوصول إلى تصور شامل للتوصيات الخاصة بالتصميم المعماري الذي يلبي متطلبات التعلم الحديثة.

الكلمات المفتاحية: نموذج صناعة التعليم، التعلم في القرن العشرين، التعلم في القرن الحادي والعشرين، مهارات القرن الحادي والعشرين، تصميم المدرسة، مصر

إقرار

هذه الرسالة مقدمة في جامعة عين شمس وجامعة شوتجارت للحصول على درجة العمران المتكامل والتصميم المستدام. إن العمل الذي تحويه هذه الرسالة قد تم إنجازه بمعرفة الباحث سنة ...

هذا ويقر الباحث أن العمل المقدم هو خلاصة بحثه الشخصي وأنه قد اتبع الإسلوب العلمي السليم في الإشارة إلى المواد المؤخوذه من المراجع العلمية كلٌ في مكانه في مختلف أجزاء الرسالة..

وهذا إقرار مني بذلك،،،

التوقيع:

الباحث: ساندرا نبيه سمير لبيب

التاريخ:07/28/2021

مراجعة أساسيات تصميم المدارس لتتوافق مع متطلبات التعلم في القرن الحادي والعشرين:

حالة المدارس الحكومية المصرية

مقدمة للحصول على درجة الماجستير في العمران المتكامل والتصميم المستدام

أعداد: ساندرا نبيه سمير لبيب

لجنة أشراف

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أستاذ التخطيط االقليمي والعمراني
جامعة عين شمس

أ.د هبة صفى الدين
أستاذ العمارة و التصميم
جامعة مصر الدولية

لجنة الحكم

أ.د .....الممتحن الخارجي
أستاذ.....
جامعة .....

التوقيع

أ.د.....
أستاذ.....
جامعة .....

أ.د.....
أستاذ.....
جامعة .....

تاريخ المناقشة:.....

الدراسات العليا

ختم الإجازة

موافقة مجلس الكلية .../.../...

أجيزت الرسالة بتاريخ:.....

موافقة مجلس الجامعة .../.../...

جامعة عين شـــــمس

مراجعة أساسيات تصميم المدارس لتتوافق مع متطلبات التعلم في القرن الحادي والعشرين

حالة المدارس الحكومية المصرية

رسالة مقدمة للحصول على درجة الماجستير في العمران المتكامل والتصميم المستدام

إعداد

ساندرا نبيه سمير لبيب

المشرفون

.أ.د يحيى سراج
أستاذ التخطيط االقليمي والعمراني
جامعة عين شمس

.أ.د هبة صفي الدين
أستاذ العمارة و التصميم
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