Participatory Architectural Design and Construction Framework in Primary Schools with Reference to a Local Case Study in Egypt

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Abstract

Can more efficient adaptive creative learning environment in primary schools be achieved through participatory school design projects which target the school's students as main participants?

Through this study a set of elements of effective children participatory strategies are illustrated and developed from general recommendations for participatory design-build projects to structured guidelines for participatory school design based on results from local case study in a primary governmental school in Egypt.

The first part of the study provides a theoretical base for the concept of children participation in their environments and illustrates the meaning, the nature, and the process of children participation and it addresses the topic of children in low income communities. The second part of the study focuses children participation and the school environment. It addresses the change in learning environments and how this affected the school design process within a case study that tests participatory guidelines and proposes a criteria for school design-build framework.

Keywords: school architecture; design methods; design with community; participatory framework.

I. INTRODUCTION

Cities in developing countries face similar challenges in attempting to cope with the phenomenon of rapid urbanization. Their ability to cope with such challenges is largely contingent upon their limited resources and the institutional framework in which they operate. Social organizations, cultures, administrative traditions, planning conventions and political dynamics vary considerably from city to city, and country to country [1]. When we talk about Egypt considering the rapid population growth -26 million in 1960 to almost 90 million in 2014 - with approx. 200,000 primary and secondary schools with some 10 million students in Egypt [2]. With this big number of students comes a great responsibility for the government to provide an appropriate

affordable education for these children, but on the other hand Egypt is a third world country with economic crisis and unstable political situation which affects the short and long-term plans of development, and the educational situation in Egypt can be described as very complex, as public education is struggling to provide quality education which is very difficult considering the shortage in facilities, lack of well-trained educators and inflation in classes. All of these factors affect the educational, social and built environment provided in the schools.

The success of any community and any development process is measured by the involvement of the urban inhabitants themselves [3] as main actors in the educational process and how much freedom and space is provided for them to enhance their abilities throughout the different educational stages. One way of activating these possibilities is participatory design-build framework which is based on down top strategy and giving power to the school students and this is considered as a counter strategy for the on-going top down school design strategies going on in Egypt right now.

Children/students are always connected to their schools, and the daily experience they encounter in their schools plays a great role in shaping their future and their perception [4].

II. PARTICIPATORY CRITERIA

Primary students' participation is a process in which children and youth engage with other people around issues that concern their individual and collective life conditions. Participants interact in ways that shows respect each other's personality, with the aim of achieving shared goals. In this process also; the child experiences and visions are playing an effective role in the community [5]:

Forms of Student's Participation

The forms of participation can be categorized according to the level of child/student engagement and control [3] as follows:

- Prescribed participation: with set and predefined child role, the child feels that he is obliged to participate as part of his cultural and communal role, and the chance to participate is a privilege.

- Assigned participation: adults provide opportunities for children to participate and also direct the process of children participation.
- Invited participation: adults provide and control the process but children can withdraw when they want to.
- Negotiated participation: the child can negotiate how to be involved into the participatory process.
- Self-initiated negotiated participation: the child initiates it and controls it and decides for how long to carry on with it.
- Graduated participation: the child has opportunities to practice new types of participation with higher responsibility and involvement in the community.
- Collaborative participation: it is initiated and supported by a group. They negotiate the level and the type of involvement.

Participatory design build strategy steps

The levels/forms of participation developed in the previous point will be the first part of the suggested participatory criteria proposed in figure 01 and fully illustrated at the end of the research. The seven suggested levels of participation can work within a matrix theme as shown in figure 02 where one stage of the participatory design/upgrade process can contain one or more participatory level in order to maximize the efficiency of the overall participatory design/upgrade process.
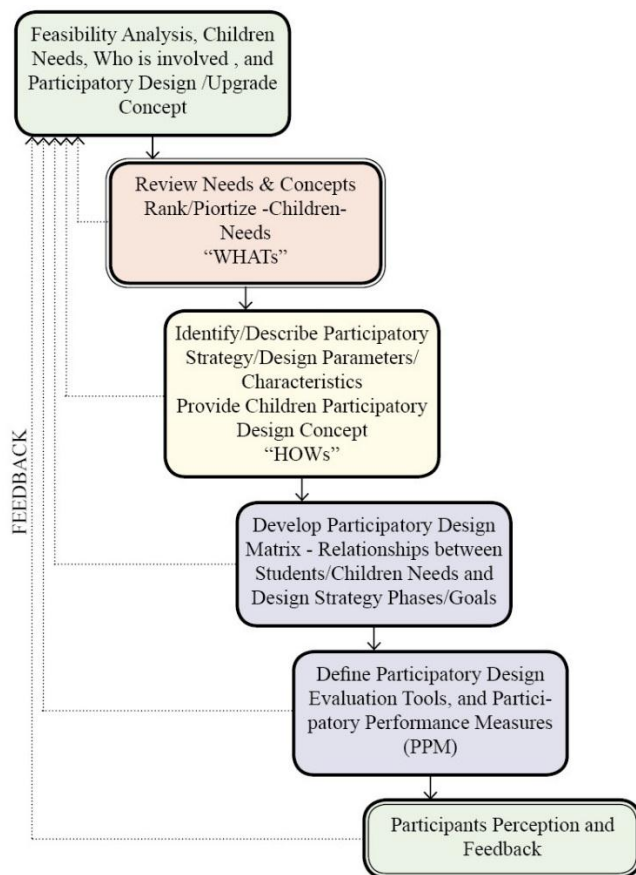

Fig. 1. Basic Participatory Design/Upgrade Process

Design/Upgrade Program Stage(s)			Forms of Student/Children Participation	
		01	Prescribed	
		02	Assigned	
		03	Invited	
		04	Negotiated	
		05	Self-initiated	
		06	Graduated	
		07	Collaborative	

Fig. 2. Forms of Participation Matrix

III. LOCAL CASE STUDY

The design-build study took place in primary governmental school; Asmaa Bnt Abu Bakr School in the first settlement, New Cairo, Egypt.

Asmaa Bnt Abu Bakr School is located in a new settlement outside the old city of Cairo. The first settlement has a series of neighborhoods in it. The school is located on the third neighborhood on the edge between the third and the fifth neighborhood. The third neighborhood is for low income housing units and full of Syrian refugees living in it, but on the other side; the fifth neighborhood is for high income residential units with villas and fancy apartment buildings facing the low income neighborhood and the school as well as illustrated in figure 03.

The school is special because it has kindergarten, primary, and elementary levels in it which raised the challenge to design a suitable elements for children (mainly in Kindergarten and primary levels) and also consider the youth of the elementary level and how they use the courtyard. The school has one main building with single loaded corridor plan typology. It has a relatively huge courtyard used as playground and assembly space for the students (more than 2000 student in the school). The courtyard also has no furniture in it.
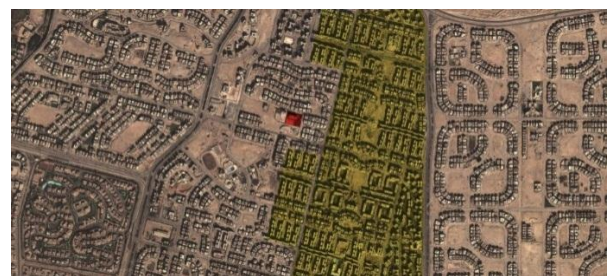

Fig. 3. Asmaa Bnt Abu Bakr School Urban Location with Middle/Low income Housing Highlighted in Yellow (Google Earth, 2020)

Fig. 4. Asmaa Bnt Abu Bakr School Courtyard and Setting (Photo: Vittoria Capresi)

Working with School's Children Strategy

The participatory strategy of the design build study started with brain storming about the team, materials, children and teacher's workshop strategy. Around twenty children from the school were involved in the design-build project, also a team of pedagogues (included professors and students from Siegen University in Germany) were included in order to work more effectively with the schools teachers.

The material provided to children for their collages was more physical materials instead of abstract images. The amount of construction materials was decided and distributed according to the size of the school courtyard and the intended implementations.

School's Students/Children Participatory Workshop

The team was divided into groups; each group has Germans and Egyptians (Architects, Landscape Architects, and Pedagogue). Each group was responsible for one or two children.

The children were asked to create their dream playground, a space where they can spend their dream day which doesn't have to be limited to the school. The children started to tell the responsible teams their memory/vision of their best day or their dream day. Some told stories about a day in the park with the family, or a soccer game, or a day by the beach ...etc.

The leaders of small teams listened carefully to students' stories and started to help the students to transform these stories/ dreams into physical collages with spatial qualities. The children were provided with various physical materials (check figure 05) such as; foam, papers with different colors and textures, plastic sheets, cardboard, fabric, foil ...etc.

Fig. 5. Sample of the Model Making Materials Provided for the Children (Photo: LMPG2)

Using the technique of physical models made it easier for the team to filter and analyze the spatial qualities and intended activities from the children's models. Using physical materials also gave the children the chance to activate their touching senses, they choose materials with soft or hard or smooth surface ...etc.

Fig. 6. Children Workshop using Model Making Materials (Photo: Author)

From another point of view; the physical material limited their representation/transformation of the children's dream day into models, as it was limited to a certain variety of materials, unlike the abstract images which provided a wider range for imagination/interpretations.

The children were asked to name their models, and started to present their work to all the other participants; they started by telling their story and how they imagine themselves occupying and using the space they created in their models.

Most of the children had a rational space (soccer field, seating area, walls, house, beach …etc.) within their models and they added they creative ideas to it. During the children's presentation they also mentioned with whom they want to share their dream day, and they explained/imagined how the people they choose to join them will act and use their dream day model/space. The previous data was important to achieve more understanding for each child personality and needs, and how it might be turned into actual built elements in his/her school courtyard.

- **Teachers Workshop**

Teaches were involved in the whole process and consulted through the different phases of work, and their feedback affected the process as well.

In order to fully activate the teachers' role, a workshop with them took place. It was held in parallel to the children's workshop with the presence of the pedagogues. A printed layout of each school and a number of figures with various colors and various functions written in them (like: stage, singing, seating, outdoor learning, jumping, hide and seek ...etc.) were provided to the teachers along with interviews from the team. The goal was to get the teachers perception based on their experience with the children; get their perception about how the children use the courtyard in its current condition the potentials and problems, and how it might be improved. The teacher's input in how the different intended activities/functions was important in order to link the children input with the teachers to achieve a sustainable output where all the involved parties are activated.

- **Transferring into Designs**

After the presentations the participatory design build team in the school gathered the physical models done by the children

and started to write down their impressions, brain storming of ideas, and how can the team transform the children's dreams into a physical built environment/playground.

The first step was to transform their stories into physical actions using simple keywords like: retreating, observing, climbing, relaxing, hiding, flying, jumping, resting, gathering, sitting, chatting, sliding, snuggling, sensing, chilling, …etc.

The second step was to form groups of keywords which can work together in order to start working on how each group will be transformed into playing and learning built elements into the schools' courtyards.

The keywords were related to school's courtyard based on the team observations and the input from the teachers' workshop.

o   *Phase One: Physical Dreams*

The architecture students were asked to transform the dream day physical models - shown in figure 06 - of the students they mentored into spatial physical models. They were asked also to use the material provided for the children. The goal from this phase was to be free constrains such as structural matters, cost, and dimensions …etc. in order to get started, fully activate the potentials in the students' dream day modes, and transform actions/keywords into physical objects.

Various design proposals were done expressing the different spatial qualities and the different experiences such as; discovering, exploring, conquest, dark spaces/cave, switching, private space, expecting, observing/setting above, waiting, diversity, chain intersection …etc.

Fig. 6. Sample of the Children Models (Photos: LMPG2)

These qualities and experiences illustrated in the models were explained and achieved through a description of actions within the spatial designs like; sitting above or beneath, hiding under or behind, climbing up and down, jumping …etc.

The teams' spatial model proposals investigated different materials effects (shiny, transparent, reflective …etc.), different colors effect, different spatial qualities/alternatives (enclosure within a space, repetitive elements, verticality, horizontality, scale of elements, linear, centralized, curved …etc.) , the patterns of shade and shadow within their

proposals, and how these elements are related to the data/keywords adapted from the previous phases.

o   *Phase Two: Design within the School Setting*

Each group was asked to develop a common idea/proposal which complies with the selected location for implementations. The selected locations were selected based on the team discussions and teachers' input. Safety measurements were considered in selecting the implementations (like the playground material: soft/sandy material is suitable for running, climbing, and jumping, hard materials like tiles or concrete flooring are more suitable for quite/less risky activities like sitting and chatting or hiding). The new implantation should take in consideration also the available construction materials (bricks, cement, sand, gravel, and wood in both schools).

The architecture students spend the first day of the design studio doing their proposals, and by the end of the day each school teams presented their work and got feedback from their colleagues and from the team professors. Based on the feedback they got they were asked to develop one design idea for each site within the school. The teams also were asked to build their proposals within a physical model for the school.

In Asmaa Bnt Abu Bakr School; the courtyard was divided into two zones as illustrated in figure 07. First zone was the main assembly/soccer field area in front of the school entrance, which was divided into two subzones, one with tiles for the flooring and one with sand/soil for the flooring. The second zone was a narrower linear zone located between the school fence and the school building, which was mainly for kindergarten children.

Fig. 7. Asmaa Bnt Abu Bakr Courtyard Activities/Functions Distribution

Fig. 8. Jump/Climb/Balance Object Proposal (Photo: LMPG2)

Three teams worked on the courtyard; the first team worked on developing hide and seek seating areas for children and teachers in the sandy area in the first zone, the second team worked on developing a jump/climb/balance object (figure 08) also in one of the sandy areas in the first zone, and the third team worked on developing a seating and chatting objects in the areas with tiles in front of the school building.

IV. FINALIZING DESIGNS/ BUILDING

The teams presented the design proposals in the school for teachers, school director, and children. The design methodology and process of transforming the dream day models into design proposals were explained.

The design ideas were presented using physical models for intended implemented objects and a school physical model. The school physical model made it easier to explain the ideas to the children and teachers as well.

After the discussions and feedback from the children and teachers in the school the design teams were asked to start doing the final adjustments and start developing construction and structure proposals for their designs. In the final design phase the durability and safety measures should be considered, also the allowed time frame for building (three days) affected the final design results (in size and amount of suggested objects, with –again- careful consideration for safety measurements, shading, and agreed functional suitability/zoning. The children were involved in the building phase as well in order to create some sort of personal ownership and commitment towards the new objects.

One of the main goals of the project was to involve the community in the participatory process; based on that approach the brick workers in the school were from the school's neighborhood, and the construction material suppliers were also from the school's neighborhood, which helped the community to understand and accept the ongoing participatory process.

Fig. 9. Brick Worker House in Green Circle & Construction Material Supplier Location in Yellow Circle (Google Earth)

Fig. 10. Final Result Climb/Jump/Seating/Balance Element (Photo: LMPG2 Team)

V. PARTICPATORY PROCESS SUMMARY

The participatory process in the four selected schools can be summarized in the following points.

- Workshop with the children (create your dream day, model presentation, and model analysis)
- Teachers' workshop,
- Transferring into designs (physical dreams, design within the school setting, and children and teachers presentation/feedback)
- Finalizing design (let's build) and Final Results.

A participatory guideline was developed based on the previous four points. The school guideline can also be used as a tool of design strategy planning and also as an evaluation tool, as it shows which criteria was chosen in the participatory design strategy and how effective these criteria were activated in the selected example by comparing the original criteria matrix to the new one.

The guideline analyzed the four points in relation to list of main characteristics of co-design participatory process as follows:

- Participatory Process PP
  - Prescribed
  - Assigned
  - Invited
  - Negotiated
  - Self-initiated
  - Graduated
  - Collaborative
  - Explorative learning EL
  - Observation
  - Exercising
  - Space research
- School curriculums SC
  - Applied curriculums
  - Children/space dialogue
- Local environment LE
  - Outdoor comfort
  - Indoor comfort
  - Adaptive design

- Local culture LC
  - School role
  - Local community
  - Gender
- Place experience PE
  - Workgroup
  - Learning
  - Leisure
  - Space Geometry
  - Spatial perception
- Emotional significance ES
  - Own creation
  - School of dreams
  - Space memory

- User imagination UI
  - Children form environment
  - Manipulation
- Temporal aspects TA
  - Ownership
  - Uses/activities

The guidelines can be adapted to fit different educational environments and facilities. In the current chapter the guidelines are used for analyzing the participatory strategy in designing and upgrading school courtyards.

The relative weight/importance of each element/criteria within the special school design guideline v01 was elaborated and a draft/theoretical comparison of the relative weights was done (check Table 1, Table 2, and Figure 11).

TABLE 1. Guideline(s) Total and Actual Load(s) Comparison.

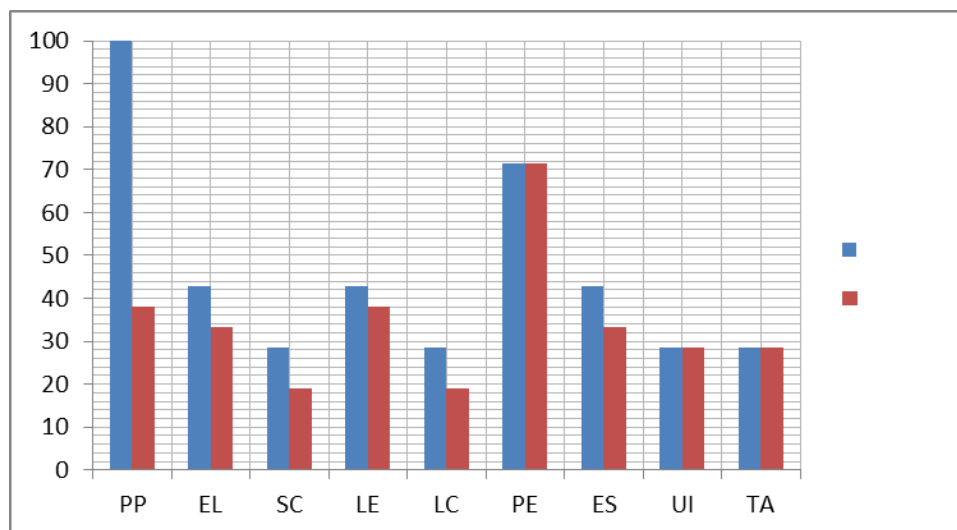| Guideline	Total Load %	Actual Load %		
PP	100	38.10	PP	Participatory Process
EL	42.86	33.33	EL	Explorative Learning
SC	28.57	19.05	SC	School Curriculums
LE	42.86	38.10	LE	Learning Environment
LC	28.57	19.05	LC	Local Culture
PE	71.43	71.43	PE	Place Experience
ES	42.86	33.33	ES	Emotional Significance
UI	28.57	28.57	UI	User Imagination
TA	28.57	28.57	TA	Temporal Aspects

Fig. 11. Guideline(s) Total and Actual Load(s) Comparison

A survey was done to compare the relative importance of each element of the proposed criteria with the assumed data based on literature review. The results are shown in figure 12-14.
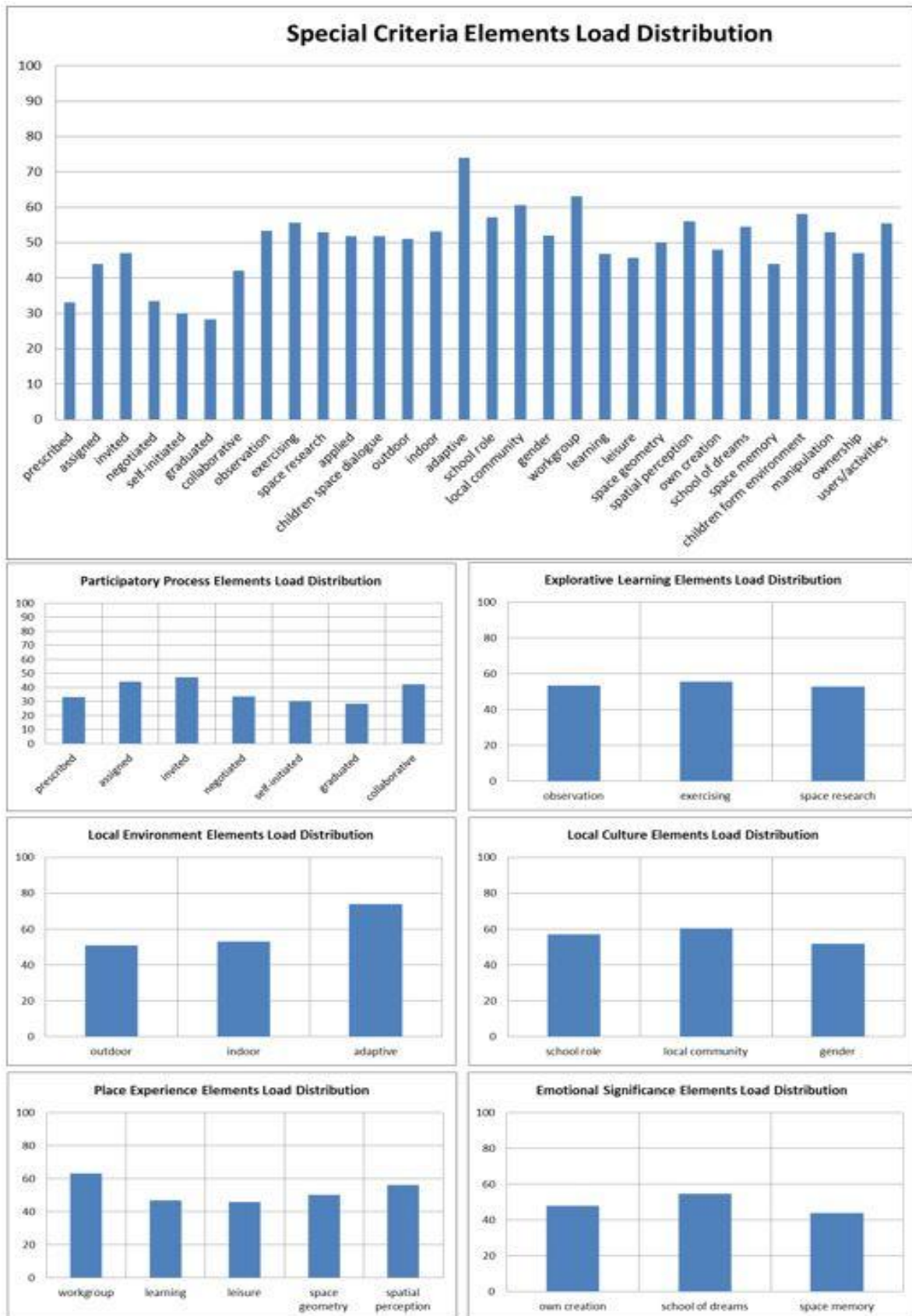

Fig. 12. Selected School Special Guideline Criteria Load Distribution based on survey results

Fig. 13. Selected School Special Guideline Criteria Load Distribution based on assumed data from literature review.
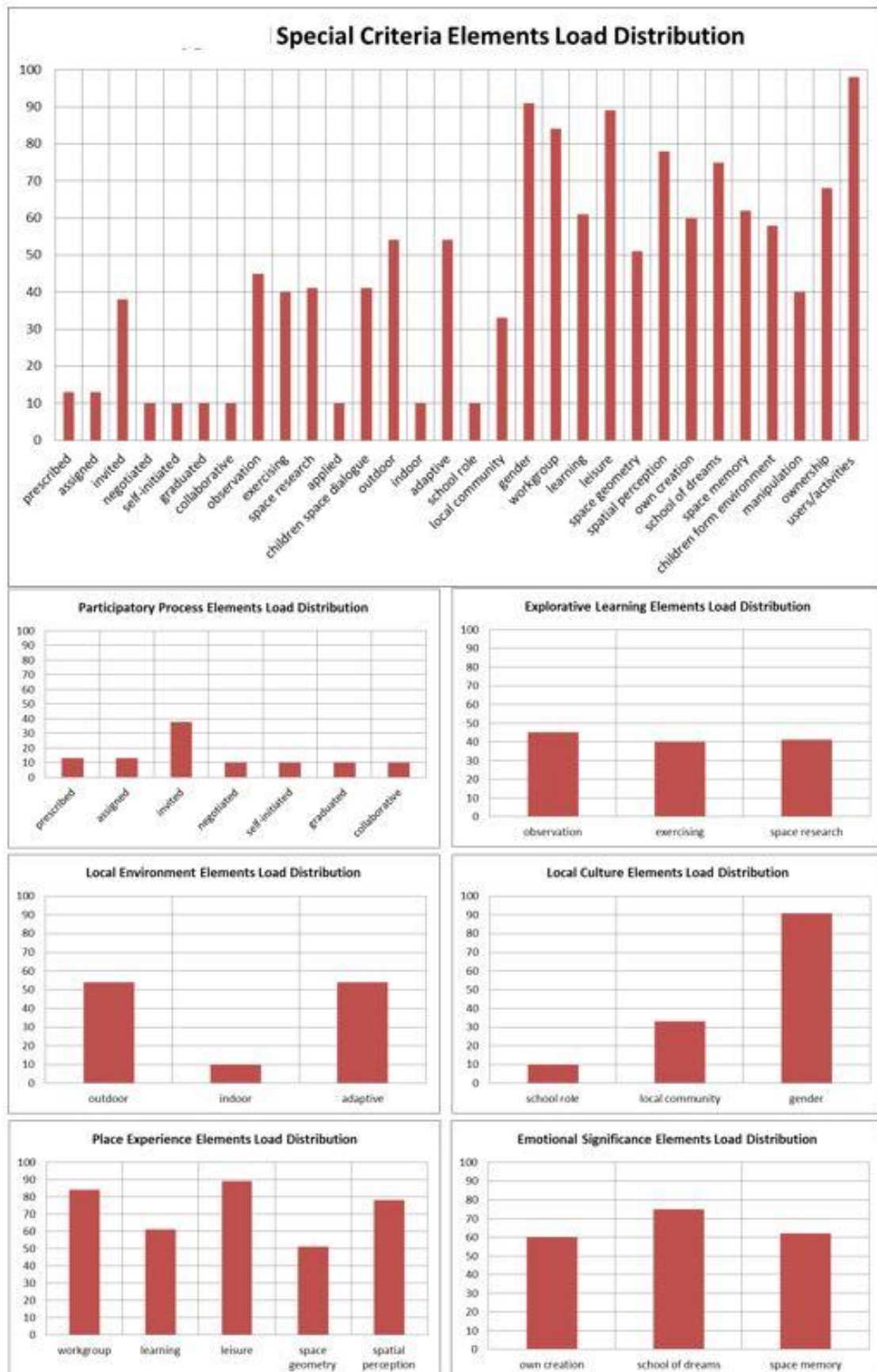
Fig. 14. Selected School Special Guideline Criteria Load Distribution based on data from case study.
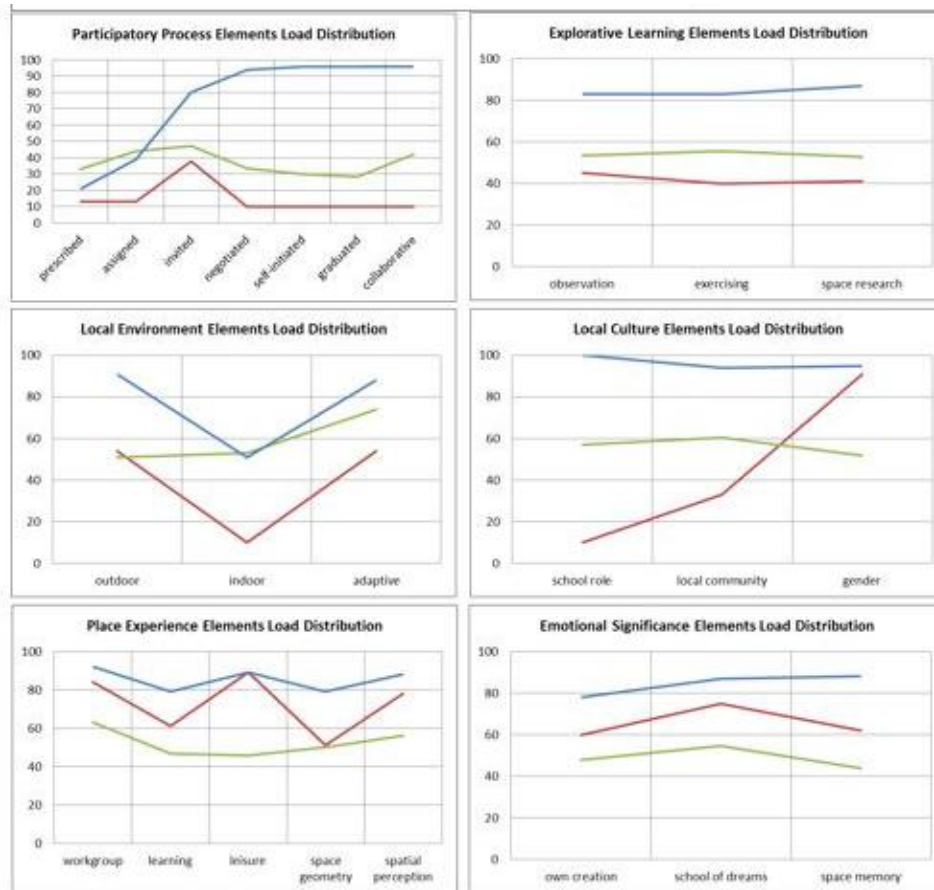
Fig. 15. Overall Comparative Special Guideline Criteria Load Distribution

TABLE 02. Special School Design Guideline for Local Examples Participatory Strategy

Guideline	Children workshop				T	Transfer into design			Final stage			Guideline Criteria
	Dream Playground	Collage Presentation	Collage Analysis	Activity Diagram	Physical Dreams	School Setting	feedback	Finalizing Proposals	Building	Final Results		
Participatory Process			●			●		●		●		Prescribed
										●		Assigned
	●	●			●					●		Invited
							●		●	●		Negotiated
												Self-initiated
												Graduated
												Collaborative
Explorative learning				●	●	●			●	●		Observation
					●			●	●	●		Exercising

| Guideline	Children workshop			T	Transfer into design			Final stage			Guideline Criteria
	Dream Playground	Collage Presentation	Collage Analysis	Activity Diagram	Physical Dreams	School Setting	feedback	Finalizing Proposals	Building	Final Results	
				●	●			●		●	Space research
School curriculums											Applied curriculums
				●		●				●	Children/space dialogue
Local environment				●	●	●		●		●	Outdoor comfort
											Indoor comfort
					●	●		●	●	●	Adaptive design
Local culture											School role
				●					●	●	Local community
	●	●	●	●	●	●	●	●		●	Gender
Place experience	●	●	●	●	●	●		●	●	●	Workgroup
			●	●		●	●	●	●	●	Learning
	●	●	●	●	●	●	●	●	●	●	Leisure
			●		●	●		●		●	Space Geometry
	●	●	●		●	●		●	●	●	Spatial perception
Emotional significance	●	●	●		●		●	●		●	Own creation
	●	●	●		●	●	●	●		●	School of dreams
	●	●	●		●				●	●	Space memory
User imagination	●	●	●		●			●		●	Children form environment
					●	●		●		●	Manipulation
Temporal aspects	●	●	●		●	●		●		●	Ownership
	●	●	●	●	●	●	●	●	●	●	Uses/activities
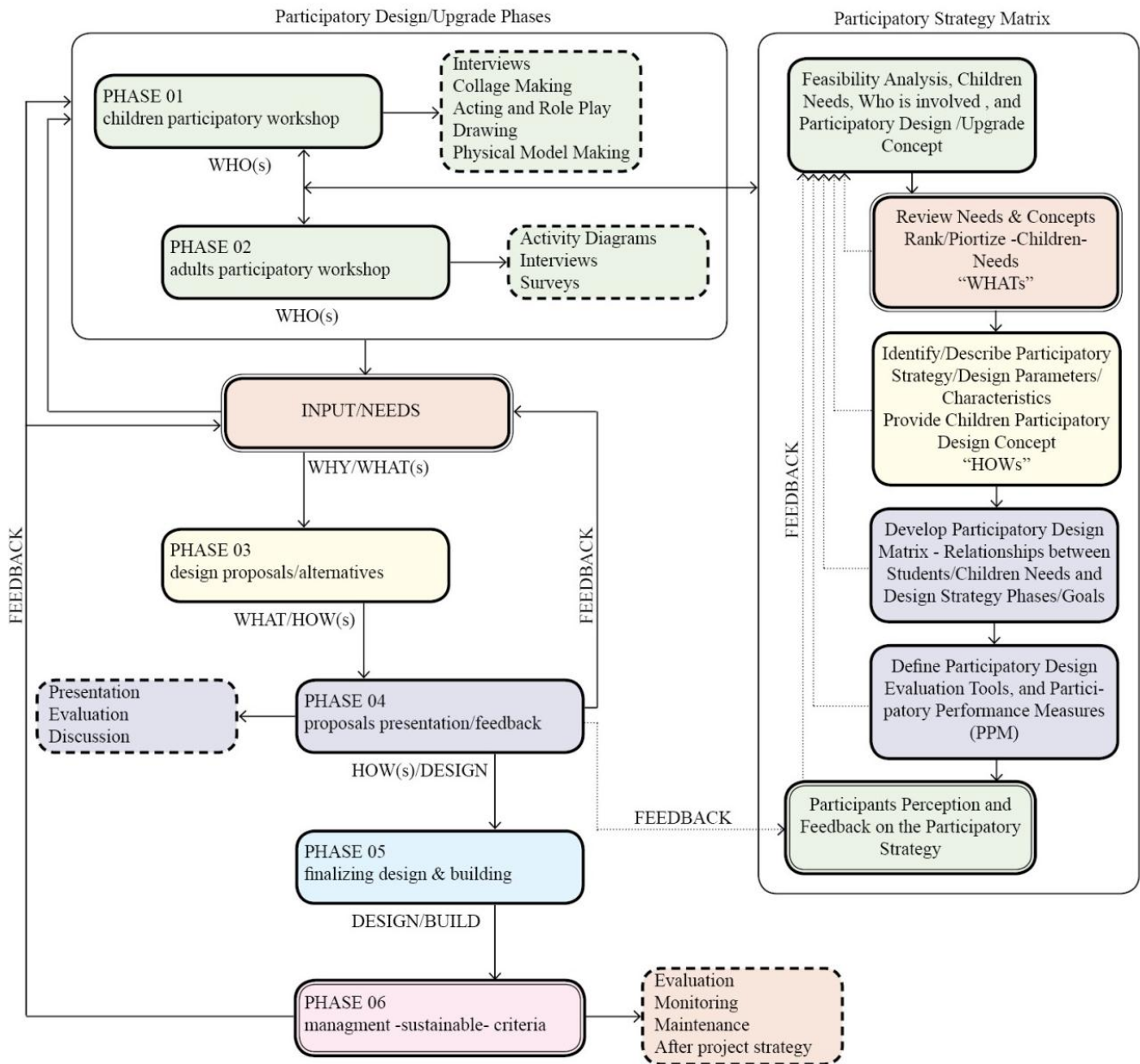
Fig. 16. Combined Participatory Design/Upgrade Strategy and Phases

VI.   CONCLUSION

Combined Participatory Design/Upgrade Strategy and Phases proposed in figure 16 proved to be suitable for different settings/context as shown in the analysis. On the other hand the strategy proved to be facing problems with the huge numbers of students in New Cairo School where the strategy was done to be processed with twenty to thirty children per school while the ideal number of students range between ten to fifteen students. The different approaches in the children workshop phase demonstrated the strength and weaknesses in each choice; when the children were provided with physical model materials the results were limited in most cases to the actual physical environment they encounter in their daily life, but it was more efficient when it came to transforming their dream models into a spatial physical model.

The involvement of other parties other than the children proved to be useful for the project as it helped with providing the local materials through the support of the local material suppliers, a better and more elaborated understanding of the school situation was gained through the interaction with teachers and community, and the cooperation between the local craftsmen and professionals from the team resulted in advanced modifications and customization to building techniques and participation strategies onsite such as; brick construction techniques, foundation and structure for wooden elements, the implementation location and durability according to the children expected use, and the final design and construction decisions regarding the heights and coloring …etc.

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