UNDERSTANDING SCHOOL DESIGN PROCESSES

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Abstract

This paper presents the results of an investigation of the design process of school buildings in the state of São Paulo in Brazil. The study was based on structured interviews with the architects who in the last decade designed schools for the local school building agency – Fundação para o Desenvolvimento da Educação (FDE). Guiding principles for the questionnaire were extracted from the literature on high-performance school design processes. The results show that the design process is primarily influenced by the agency FDE. This process was compared to recommendations found in the literature. Some opportunities for change could be identified and the characterization indicates the need for better assessment tools and access to technical information directly applicable to design issues. The results showed a predisposition for change by professionals. New building projects are opportunities to question the status quo. The characterization of the local design process and understanding the positive attitude of its architects in detail is seen here as an important, however small, step to bring about improvements in education as a whole in the conditions described.

Keywords: architectural design process, design practice, school design, school buildings, design methods
1. **Introduction**

This paper presents the results of an investigation of the design process of school buildings in the state of São Paulo in Brazil. The study was based on structured interviews to characterize the design process adopted by these professionals. Most cities in Brazil still present a large deficit of schools, demanding new constructions. Such buildings must deal with new requirements brought on by social, economic and technological changes, which the design process must take into account. The investigation of the present process is important to identify bottlenecks and opportunities to introduce positive changes in the process itself and indirectly the design solutions proposed.

Understanding how school buildings are conceived was the main focus of this study. Research on school buildings in general and their influence on the quality of school environments inspired the study and Post-Occupation-Evaluations (POE) of local school buildings provided the background for the need to improve such constructions. Understanding the school design process in its specific context was also considered an important step in finding new ways of providing local communities with higher quality school buildings and contributing to an improvement in education in general.

2. **Schools in the Local Brazilian Context**

Free and compulsory primary and secondary education is an important instrument to promote social progress, and in developing countries, such as Brazil, the importance of education cannot be underestimated. Primary and lower secondary education, called Fundamental Education, is free and
compulsory for children between the ages of 6-14 in Brazil, while upper secondary education for the ages 15 to 18 is also free but, not compulsory (BRASIL, 1996). To attain the positive impact expected from state run school systems\(^1\) these institutions need to address issues that impact society and make sure that future citizens are capable of meeting the challenges that lie ahead. Schools should set an example to adequately represent the desired values of a specific time and place. These values can be externalized through curriculum content, teaching methods and an engaging, comfortable and attractively built environment, expressed through school architecture (SAMAD & MACMILLAN, 2005).

A growing number of studies show that the quality of the physical environment influences users, their productivity, level of stress and physical and mental health, as well as their sense of self-esteem, and it stands to reason that the school environment as a whole must consider the latest findings on this interrelationship, if improvements in education are to be effective. Many case studies have shown that school buildings with poor ventilation, inadequate lighting and acoustic conditions, as well as unfavourable heating or cooling systems, have direct consequences on well-being factors of its users (EARTHMAN, 2002; TANNER, 2000; FISHER, 2007; SCHNEIDER, 2002; HESCHONG, 2003; BOMAN & ENMARKER, 2004; HIGGINS et al., 2005; TIBURCIO & FINCH, 2005; MARTIN, 2006; DURAN-NARUCKI, 2008; LIPPMAN, 2010; BARRETT et al., 2013).

\(^1\) Government run education in Brazil for the general population is usually called public education. Free fundamental education is primarily provided by municipal administrations, but also by state governments, as is the case of the state of São Paulo. Private institutions are also very much present in the basic education scene of Brazil, mainly catering to middle class families. In this study reference is given to public education supported by the state, thus called state education in this paper.
International discussions on improvements to education include the adequacy of the physical environment to support new educational goals. A building project is seen as an important opportunity to reflect on the various issues which impact education (SANOFF, 2001; FISHER, 2007; DUDEK, 2008; TAYLOR & ENGGASS, 2009; NAIR et al., 2009; FORSYTH et al., 2011).

The primary issues to be considered in a school design process are usually related to functional aspects of the building, to embrace the educational activities indicated by the pedagogy and educational system adopted. Architectural programs need to stimulate the design process with up-to-date information on the dynamics of education (SANOFF, 2001 & 2011; MOREIRA & KOWALTOWSKI, 2009; KOWALTOWSKI et al., 2013). Design issues change over time and are place-specific and one of the more urgent issues of social progress today, on a global scale, relates to environmental questions and the means of implementing a society with more sustainable attitudes (FORD, 2007). Schools have a key role to play through their educational principles as well as through sustainable architecture (KENNEDY, 2011; GELFAND & FREED, 2010).

In Brazil, the quality of state supported education has been under debate, especially in light of recent unsatisfactory performance levels achieved by students (IDEP, 2013). To explain the poor quality of basic state supported education in Brazil many studies relate problems to historical causes and have brought forward possible ways of overcoming the present situation (BRUNS et al., 2011). Improving the educational system requires new pedagogical practices, new curricula, better teacher training, new assessment methods and making the latest educational technology available (LOCKHEED & LEVIN, 2012; CASTRO & OLIVEIRA, 2009).
Reforms in education take time and need social consensus and backing. Change should start at the basic education level and expand upward.

The infrastructure of schools and their physical environment are seldom part of general recommendations to improve education. However, the need for change to school buildings in Brazil can be corroborated by results of Post-Occupancy-Evaluations (POEs) (ORNSTEIN, 1997; KOWALTOWSKI et al., 2001; AZEVEDO et al., 2004; ORNSTEIN, 2005; MUELLER, 2007; da GRAÇA, 2008; BATISTA et al., 2010; SOUZA FILHO et al., 2010; ELALI & SOUZA, 2011). Such studies show that problems related to environmental comfort are frequent and that schools lack a variety of spaces to support a rich array of recommended educational activities. Current design parameters therefore need questioning. Also such results must be made available to the design profession to avoid repetition of errors.

Although the study presented in this paper advocates in favour of high-quality school environments, the authors are aware that architectural design alone cannot change an educational system of a nation, especially with the dimensions of a country like Brazil. On the other hand, a detailed knowledge on how school buildings are conceived is seen as an important contribution to shed light on the various factors that influence the quality of school environments and this understanding may then indirectly contribute to an improvement in education in general (DELIBERADOR 2010; KOWALTOWSKI, 2011).

To collect data to this effect, a study on the design process of state schools in Brazil is presented here, with emphasis on the State of São Paulo, where
school buildings are managed by a government agency called FDE (*Fundação para o Desenvolvimento da Educação*). FDE is responsible for all state schools in São Paulo, which in 2013 comprised approximately 5000 buildings. FDE supports more than 5 million students, making it the largest foundation of its kind in Latin America (FDE, 2010). An example of a typical school building in the State of São Paulo is shown in Figure 1.

### 3. Recommended and Local School Design Processes

To establish the structure and content of what may be termed a recommended design process for school buildings some consensus should be reached on what constitutes a quality-architecture for schools. Recent literature on design methods has shown that the design process in general is becoming more complex as new requirements are imposed on teams (LAWSON, 2006). Figure 2 shows a model of the contemporary design process with its spiralling movement during the design development phase.

Present-day school environments should respond to complex demands emanating from educational specifications, specific pedagogies and design guidelines to accommodate desired learning and teaching activities (UPITIS, 2004; NAIR et al., 2009). Nair, Fielding and Lackney declare: “Educational specifications create a school before it is created and design guidelines are too prescriptive, so that architects are often relegated to the role of assembling pieces instead of doing real design.” (NAIR et al., 2009, p.14). This somewhat negative affirmation demonstrates that the school building design process is far from resolved, even in countries with advanced regulations and a technologically developed building industry.
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The literature on high-performance schools can indicate common patterns in relation to the meaning of what constitutes good architecture for school buildings and how to achieve such quality solutions. This literature is vast, discussing tendencies in education and the architectural response to new teaching methods and their necessary technological support (DUDEK, 2007; FORD & HUTTON, 2007; WOOLNER, 2009, TAYLOR & ENGGASS, 2009; UPITIS, 2010; HILLE, 2011) Architectural concepts are established to ensure a quality educational setting. These concepts must be adjusted to specific local conditions to be effective. Architectural space should be considered the third teacher in supporting the educational environment of excellent teaching staff, school material and equipment as well as the application of a responsible curriculum and a creative pedagogy (NAIR et al., 2009; O’DONNELL WICKLUND PIGOZZI AND PETERSON, ARCHITECTS INC., 2010)

Post-Occupancy-Evaluations (POEs) of school buildings are important sources for the identification of environmental quality, building performance pathologies and human response measurements. Data from such studies should be incorporated into a school design process to avoid the repetition of errors. In countries with good minimum standards of environmental comfort, such studies indicate that not all problems are eliminated by regulations and that an appropriate environment depends on many interconnecting factors (EARTHMAN, 2002; TANNER, 2000; SCHNEIDER, 2002; BOMAN & ENMARKER, 2004; HIGGINS et al., 2005; TIBÚRCIO & FINCH, 2005; MARTIN, 2006; DURAN-NARUCKI, 2008; LIPPMAN, 2010).
In addition to issues of comfort, school buildings need to address wider issues of architectural quality to make the school community feel at home and stimulated. Sanoff (2001) emphasizes the image of a school as a priority and his design methodology is based on principles for high quality school buildings. Schools should have stimulating environments in general; places for group learning; linked outdoor and indoor places; enriched circulation spaces (corridors, entrance halls, etc.); safety; spatial variety; flexibility; rich access to resources; active and passive spaces; personalized spaces; and finally extension of the school environment to the community as a learning place.

The quality of a school building depends on known design criteria and professional knowledge and practice, as well as feedback from building performance assessments and design evaluation tools (LAWSON, 2006; CROSS, 2011). An example of such a tool is DQI, the Design Quality Indicator, which assesses the quality of buildings according to Functionality (the arrangement, quality and interrelationship of spaces and how a building is designed to be useful to all), Built Quality (the engineering performance of a building, which includes structural stability and the integration, safety and robustness of the systems, finishes and fittings) and Impact (a building’s ability to create a sense of place and have a positive effect on the local community and environment) (GANN et al., 2003). A specific school building DQI is available.

Nair, Fielding and Lackney (2009), adapted the “Pattern Language” by Alexander et al. (1977) to improve the design of school buildings. This language consists of 25 patterns and should fit into an overall design process. A reference design process, shown in Figure 3, structures procedures for the design of high-performance schools, during which the
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quality of education should be discussed in broad terms. The reference process adds a multidisciplinary team to the process, through an integrated design process to ensure that the various specialists contribute at an early stage to design solutions (FIGUEIREDO, 2009). Appropriate tools are introduced to simulate comfort levels and other important functions of a building to avoid later as-built assessment problems. Users, or potential users (teachers, parents, students of different age levels, school officials and staff), should be involved in the decision-making process. (SANOFF, 2011; WOOLNER, 2009). But user expectations must be guided toward a proper understanding of a design’s response to needs and desires to avoid disappointment and dissolution. In this context, values are important concepts to incorporate into the design process debate (HERSHBERGER, 1999).

The commissioning phase of this process is of vital importance to implement fine-tuning of the building and to train staff and users in the proper operation of its infrastructure (CHPS, 2002) Finally, a complete POE study should yield satisfaction levels and identify positive and negative aspects of the design and building in use. This phase is essential in closing the reference design process loop while providing important feedback for new projects.

The design process described above is recommended to attain a desired school building quality. In the local Brazilian state school context, this process has not yet been fully adopted. Many efforts have been made to improve the design of school buildings, especially in the state of São Paulo, through the implementations of FDE, including the periodic
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The state school design process of the state of São Paulo was structured as shown in Figure 4 from information available from FDE. It is initiated by contracting local accredited architectural firms. The chosen professionals receive a predefined brief, or architectural program, elaborated by the State Secretary of Education and construction detailing instructions, based on modular design and prefabricated components made of concrete. The brief consists of a list of spaces and their dimensions, with some recommendation on environmental comfort aspects. The more subjective expressions of the goals, values, desires or dreams of a school community are excluded from the brief. Site conditions are provided. In addition, a list of design regulations is indicated. A preliminary design is produced and evaluated by FDE. Design proceeds, culminating in construction documentation and complementary designs (structural and installations). Some change is under way with FDE’s recent adoption of the AQUA certification process (FCAV, 2007). This new sustainability demand on projects is an opportunity for the introduction of further improvements. In the present situation minimum standards of care are required and the process is essentially linear, lacking an important feedback loop.

In Brazil, the traditional classroom dominates the school building. This configuration can stunt efforts to improve education, but to some extent, reflects the bureaucratic type of school administration found in most states and municipalities in Brazil. Teaching methods and social demands have over the years put pressure on the architectural program in favour of a more flexible brief, allowing for engagement in new activities, however
not yet reflected in school building specifications (PRADO, 2000; VEIGA, 2006; KOWALTOWSKI et al., 2013).

In most cities in Brazil the construction of new school buildings is still necessary to attend large school deficits. These new buildings must attend recommendations and programs coming from the Ministry of Education and the State Secretaries (SÃO PAULO, 2012). In the state of São Paulo FDE has made efforts to improve design quality. Stock plans are no longer used and recognized firms of architects are invited for new projects (SÃO PAULO, 2012). The specific design process of these professionals requires investigation to identify opportunities to introduce positive changes into the process itself and ultimately the design proposals as well.

4. **Methodology**

The methodological approach of the case study presented was chosen in relation to the principal goal of the investigation: the characterization of the design process from the viewpoint of the architects who work for FDE.

A case study was undertaken to gain understanding of this design process and identify opportunities to introduce positive changes that may stimulate the construction of higher quality school buildings. The interviews with the professionals documented their design process as described. The challenges faced by these designers when dealing with FDE and the possible interventions, which may improve this process, were also investigated.

The case study included an understanding of the manner in which FDE operates. For this the coordinators of that institution were interviewed.
To develop the interview tool for the case study a literature review was initially undertaken. The references revealed essential aspects of a design process for high-performance schools, as presented in Figure 3. The local process was then structured, according to information received from FDE, as shown in Figure 4.

Structured interviews were applied. A questionnaire was developed based on the important phases of a high performance design process and aspects of a quality school environment, as presented in the literature on school building design. The local design process was compared to what may be considered a reference procedure. Questions regarding the individual design process of participant architects and their relationship with FDE were included. Opportunities for change were identified, and the design concepts for high-performance schools were discussed with members of the sample.

To obtain reliable data in what Wang & Groat (2013) term qualitative research, the case study sample consisted in the total population of professionals, therefore 50 architectural firms, working under contract for FDE, over the past 10 years. Six architects were excluded from the final data presented in the results, since the interviews were incomplete, so that the final sample comprised 85% of the total population of professionals under contract for FDE.

The interviews started with the identification of the architectural firms, their size, length of experience and number of schools designed for FDE. Then, the specifics of the design approach were documented: size of the design team, design process phases and products (physical or virtual models, drawings, specifications and other documents) as well as tools
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Applied, such as simulations. The next question asked whether for school buildings these parameters are altered in relation to other building typologies. The relationship between FDE and the design team was detailed in relation to the design brief and other support material provided (codes, checklists, manuals and catalogues) and whether this information is sufficient or further fact-finding is needed. This phase of the interview closed with a question about possible changes to the way school design is currently managed by FDE. Challenges were described in relation to the size of building lots; the fixed architectural program determined by the Secretary of Education and mandatory use of precast concrete construction elements.

The next stage in the interview was on design concepts. The school pattern language was used to gage the richness of the local design process. Contemporary architectural values were considered and how they are applied in the school design process (HERSHBERGER, 1999). The integrated design process was presented. Firms responded on the possibilities of adopting such an enriched procedure. The commissioning phase was singled out as an important improvement to the current ways of designing schools. These questions were introduced to compare the FDE design process and items found in reference processes (Figure 3), and the questions about the opportunities for interventions to improve the process touched on the phases of the reference process and its recommendations.

After the interviews were completed, simple statistical data analysis was performed and presented in the results below. Percentages of answers were compiled using the non-parametric Boxplot method. This allows for
groups of numerical data (answers to question items) to be graphically depicted through their ranked set of values. The so-called whiskers in the graphs show the variability of upper and lower ranked values. Questions were further compared to the size of firms and their years of experience in design, as shown in figures 5B and 6B. The line inside the box indicates the median of these values. The dispersion of data can be identified with outliers, or less common answers, shown as circles (CHAMBERS et al., 1983).

5. Results

The results of the structured interviews showed that most of the architectural firms are small to medium sized enterprises, with 1-3 professionals for small firms and 4-10 members for medium sized firms. Only 6 of the total of 44 offices had more than ten professionals working. All firms showed that their chief designers had at least 10 years of experience.

Answers to the question on the specific design process adopted in relation to FDE and on the presence of specific aspects of the reference design process shown in Figure 3 are detailed in Figure 5 A and B. Few elements of the recommended process were found here and large firms include slightly more aspects than small firms. Experience on the other hand is shown to reduce the application of aspects of a recommended design process and firms with experience rely rather on known repertoire. These findings can be attributed to low remuneration for designs and the strict time limits (deadlines) imposed on the process by FDE. Previous experience is shown to be the guiding principle of the local design process, followed by use of reference material, which was however not
specifying in the interviews. A thorough site analysis was mentioned later in the interviews as being important, but not identified as an essential aspect of the design process.

The design parameters or “patterns” detailed in Nair et al. (2009) are almost unknown to the firms interviewed (Figure 6 A and B). Relating these results to the size of architectural firms and their experience shows that larger firms recognize very marginally more important design requirements or concerns, with one firm not considering any aspect and another identifying 7 design patterns. Experience in this case reduces the patterns considered important and one firm with little experience is an outlier, including seven of the parameters recommended by Nair et al. (2009) in their design process. One justification may be found in the difficulty in applying the patterns to local conditions. However, the results also reflect the lack of design discussions that should occur during the briefing phase. Local state schools are devoid of educationally enriching spaces such as laboratories, art studios and resource centres or libraries due to a rigid brief based essentially on a traditional classroom with fixed dimensions. Even the classroom, was not mentioned by the designers interviewed as a space which deserves special attention.

Designers mentioned environmental comfort, especially lighting and ventilation, as primary design aspects, due, in part, to FDE demands. Thus, classrooms should have cross-ventilation, afforded by the provision of large windows on the exterior wall and high clearstory windows to the corridor side of classrooms. This type of construction, however, in a double-loaded corridor scheme, does not provide for adequate levels of
ventilation in a room with 30 children for the mostly tropical (hot and humid in summer) climates of the country (HEYWOOD, 2013).

Other features, such as up-to date teaching equipment and material and built-in technology (data-shows, access to internet, smart-boards, etc.), are also not discussed in a scenario in which the state must provide pupil places and therefore quality is overshadowed by demands for more classroom space. Moreover, in state schools, practical activities that require the support of greater infrastructure, such as well-equipped laboratories, art rooms and workshops, are rare and therefore absent from the architectural program so that the state democratically provides the same levels of quality to all students.

The architects of this study singled out other parameters that are not typically mentioned in the literature. Some of these may be indirectly related to the 25 parameters presented by Nair et al. (2009). These parameters are presented with their occurrence in the survey in Figure 7.

FDE, as a client, is viewed as one of the most influential element in the architects’ opinion. Most of the designers indicated that their greatest attention is dedicated to the urban context of a school, through creative entrance solutions. This focus reinforces the importance of several patterns presented by Nair et al. (2009), such as “Welcoming entrance” and “Connected to the community”.

When asked about the challenges faced in designing for FDE (Figure 8) twenty-nine of the designers indicated that a change in design procedures would be positive. These professionals recognize that FDE has design quality in mind, but the same designers question the rigidity of the
architectural program, the design requirements in general and the bureaucracy involved in the design process. The main suggestion is related to clearer design definitions at the onset, avoiding later costly changes. In addition, architects would like to be able to specify a wider range of building materials.

The bidding laws in Brazil were indicated by 50% of the sample as having a negative influence on the design process itself. Also, the site conditions, form, dimensions and topography of typical building lots present significant challenges, because in most cities and especially in the metropolitan areas of larger cities, sites for new school buildings are remnants in outlying lower-class subdivisions. Constraints coming from the architectural program, functional space dimensions and modular design, however, do not seem to be of major concern to designers of this survey, which may be explained by the fact that school design has traditionally been conducted in this manner.

Nine key concepts for school building design were identified, through the literature review, and designers were asked to indicate which specific, personal design elements correspond to such concepts. The concepts are: relation between architecture and pedagogy (Figure 9); functional concerns (Figure 10); environmental comfort (Figure 11); costs and budgets (Figure 12); security (Figure 13); urban integration (Figure 14); aesthetic concepts (Figure 15); sustainability (Figure 16); and finally, changes over time issues (Figure 17). These concepts are closely related to design values established by (HERSHBERGER, 1999).
With respect to pedagogy, the architects had few opinions because they do not take part in any discussions on this subject prior to design development and their design process does not include a participatory briefing phase (Figure 9).

Functional aspects affect many zoning questions in the design of schools; therefore, most designers indicated specific concerns about issues regarding access and circulation spaces (Figure 10).

Regarding thermal comfort and natural lighting, school designers in São Paulo give special attention to solar protection for windows (*brise soleils*), the solar orientation of building volumes and openings and cross-ventilation. All of these elements are requirements set by FDE, and designers must justify their solutions with simulations (Figure 11).

Costs are primarily related to the specification of building and finishing materials and are regulated by FDE’s catalogue of construction elements. However, simplicity of form was mentioned by 20% of the designers as having an important effect on costs (Figure 12).

Security is an important issue in Brazilian urban areas because crime rates are high. In schools, vandalism must be considered, as well as the responsibility of a school for the well being of children. Fifty-five per cent of architects indicated that enclosing the school with a fence or wall resolves this issue, but 20% of the sample argued that visibility or transparency should be part of the design of enclosures (Figure 13).

Urban integration appears to be the most important design subject for most of the sample of this survey. Design solutions include re-qualifying larger urban areas around the school site, involving the community in new
building projects, including a plaza in front of the school gate and choosing the right entrance location in relation to the urban surroundings (Figure 14).

When reflecting on the aesthetics of a school design, most architects mentioned that the choice of building materials has the greatest impact. Colour, form and composition of architectural elements were also mentioned as being important in enhancing the aesthetics of a school design (Figure 15).

When asked to specify how sustainability affects their design proposals, most professionals stated that this concept does not affect their design directly, because they inherently seek good architectural solutions, which they therefore consider sustainable. Only 25% of the sample perceived any relation between sustainability and natural ventilation, and 20% argued that this concept is closely related to the construction system imposed by FDE (Figure 16). The low response to specific issues regarding sustainability in school design may be attributed to the fact that the study was undertaken before FDE made the certification of sustainability, through AQUA, mandatory (FCAV, 2007).

Finally, only 33% of designers are concerned about future needs for the expansion of school buildings when developing their projects. This may be due to the site conditions, which in most cases do not offer space for additions (Figure 17).

To end the interview, the 44 architects were asked to rate possible changes that should be introduced to the local school design process. A five-point
semantic scale was established to gage important phases and differences found between a reference design process, as presented in the literature (Figure 3), and the process applied in the state of São Paulo (Figure 4). The issues included in this question were as follows: the importance of a deeper debate on briefing issues; the introduction of a participatory design process in which a voice is also given to the wider school community; the importance of relating pedagogical demands to architectural solutions; increasing the technical, functional, environmental and aesthetic demands of the design of school buildings; the importance of introducing an integrated design process and a commissioning phase; the importance of making POE data accessible; better access to evaluation tools; and finally, the possibility of having specific consultants on the team at an early design stage. The answers to these questions are shown in Table 1.

Most architects considered the programming phase essential for better design solutions to emerge. The current practice of a rigid brief being handed to designers by FDE and the Secretary for Education of the state of São Paulo was criticized. On the other hand, the same designers had misgivings on the participation of users, who may not be familiar with technical issues in briefing debates. In addition, the participatory process was identified as being associated with possible ethical problems, where expectations may be high among users and delivery not always possible.

Most of the designers considered a close connection between pedagogical needs and architectural response an essential issue that can facilitate the introduction of new teaching methods. Increasing demands on the design due to educational changes were not considered a problem, because most respondents already considered demands on their designs high, mainly due
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to strict imposed deadlines for design and the small remuneration for these types of projects.

Only a few of the 44 architects knew what an integrated design process is and therefore the answers showed no specific opinion in relation to its advantages. On the other hand, integrated work with consultants on essential tasks, such as acoustics and life cycle assessment, were considered of vital importance.

Commissioning is not yet a common practice in Brazil. However, the majority of the sample considered it an interesting and important addition to the local design and construction phases of a building. POE studies and the availability of data coming from such evaluations were considered essential. Many of the participating architects lamented that POEs are not yet part of a quality design process. Access to better design evaluation tools was considered of vital importance as well. These tools should go beyond simulations of typical comfort and energy efficiency conditions to embrace other more subjective aspects of design (PIZARRO & KOWALTOWSKI, 2011).

After completing these questions on possible changes to the local process, the 44 architects were asked to provide their opinion on the possibilities of introducing these changes into local practices (Figure 18). From the responses one can observe that POE studies and commissioning are considered the most viable changes. POE studies however demand technical training, time and resources to be of effective use as design material and therefore a change in contract practices is required from FDE. Because commissioning is still not a typical practice in Brazil when a
building is finished, this phase needs proper protocols to reach its goals of smoothly handing over the construction to its final users. Also, because certifications of sustainability in the built environment are now becoming mandatory for state school buildings, it appears that designers regard POE and commissioning as valuable allies in the quest to gain experience in the increasing complexity of design.

Importance was given to more profound programming activities and the introduction of user participation. However, a participatory process is valued, but including the whole community of a school neighbourhood is considered problematic, in view of the difficulties of handling such an open-ended process.

Connecting design solutions to pedagogical needs was considered important, although less so than the programming phase, in which such issues should be raised. Designers therefore demand new attitudes of the Secretary of Education and FDE to allow for varied functional requirements. The application of increased funds for school buildings is viewed as essential to permit schools to have an enriched program that would include, a library, auditorium, laboratories and other essential spaces needed in specific neighbourhoods.

The feasibility of hiring specific consultants early in the design process, considered important, was deemed to depend on financial resources given by the state to FDE. Many of the architects interviewed expressed a real desire to contribute to the improvement of state education through quality school building solutions in a country with large social problems that remain to be tackled.
Finally, the manner in which FDE operates was further studied, and the coordinators of that institution were interviewed to complete the characterization of the school building design process in the state of São Paulo. These interviews provided a better understanding of the difficulties indicated in the interviews with professionals. Such difficulties were mainly due to the present bureaucracy and this understanding helped elaborate an enriched design process suggestion (Figure 19), which is seen as capable of being adopted under local conditions, but expandable to other realities.

6. Discussion and Recommendations

From the results of the characterization of the local design process, recommendations can be made to improve this process and consequently the design of school buildings for the education system in the state of São Paulo. The opinions of architects working under contract for FDE indicate the need for a revised design process suited to local conditions. Opportunities for interventions were identified, and an enriched design process was structured as shown in Figure 19. The adoption of such a process is seen as a possible means to improve the architectural quality of school buildings.

It seems clear that architects alone and their design proposals are unable to change a whole educational systems, however new building projects can be important opportunities for debate and the introduction of improvements as a whole. The professionals interviewed showed a real interest in intervening in the present traditional ways of proceeding, seeing school buildings as physical manifestations of an educational system. A
revised design process (Figure 19) was given support and the inclusion of a commissioning phase was seen as encouraging better interactions between users and their physical environment (HOLTZ, 2005). This phase is, as well, an important means of introducing small retrofits into buildings and a detailed record of problems can be produced through a school logbook.

Other opportunities to improve the local school building design process are the introduction of compulsory POE studies and easy access to evaluation data by architects engaged in new projects. The improved design process is no longer linear but has a closed-loop structure, with information available during the design idea generation phase (Figure 2).

The new proposal takes into account the difficult sites (urban space) available for new school constructions, found in outlying areas of cities in Brazil (risk situations 1 & 2 of Figure 19). The small size of these sites, their shape and topography demand that special attention be given to the proper siting of buildings and detailed considerations in relation to the orientation of openings and their solar-protection elements (brise soleil) (da GRAÇA et al., 2007). Stacking functions vertically also needs special care to avoid unwanted interferences and circulation patterns in design proposals.

7. Conclusions

A literature search revealed a recommended school design process (Figure 3) with several evaluation phases and importance given to participatory briefing. The design process adopted in the state of São Paulo for state schools and administered by FDE, the local agency that oversees school
building construction and maintenance, has on the other hand a linear structure (Figure 4). This process was characterized through interviews with 44 of the architects who have worked for FDE under contract in the last ten years.

The results of these interviews demonstrate that opportunities for change exist, because designers are open to new ways of developing school designs. However, their remuneration and the strict deadlines to develop such projects must be increased for such changes to be effective. FDE recently has added sustainability certification through the AQUA system to new contracts. These demands are challenges for local architectural firms, as are the continuing difficult terrains where new schools are proposed. Most of the 44 designers interviewed showed a positive attitude toward change. Their school designs are viewed as their social contributions to help the local society develop economically and culturally through better education. Designers do not necessarily demand better remuneration but emphasize the need for an increased time span to analyse specific situations with care. The same designers are in favour of a participatory process involving users in decision making and giving voice to local communities, to share their desires for better schools for their children, although with some reservations on the conduct of such participation.

An improved design process was developed to support the necessary changes in the local school design scenario (Figure 19). This new process should no longer be linear but should include a feedback loop through the mandatory introduction of POE studies and several other evaluation
phases during the design and construction of new schools. Multidisciplinary teams are important as well, especially when sustainability certification is no longer an option. Collective discussions are vital. The presence of various experts on acoustics, lighting, ventilation, energy efficiency and security as well as educators, able to outline the impact of new teaching methods on the design of spaces is important.

The methodology used in this study can be applied to other situations in which a design process requires investigation. The aspects to investigate for a design process characterization as detailed in the methodology can be applied to different contexts with necessary adaptations to include local peculiarities in relation to the design, construction and maintenance of school buildings. Many countries encounter similar conditions and difficulties in designing, building and operating state schools. Understanding how professionals cope under such pressures is seen as an important contribution to improve the design process and its products. The authors believe that understanding a design process, and therefore characterizing it, is the first step towards improving relations between designers and state clients and enhancing the quality of designs as a whole. In tandem with an enriched design process the school system needs to reflect on the impacts of various reforms and measures to improve education. Understanding the positive attitude of its architects in detail is seen here as an important, however small, step to bring about, measures to improve education as a whole in the specific local conditions described.

To support debates on the questions outlined above, further research is considered necessary. A participatory process requires structure and information data should be readily available in a language that users can
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understand. Evaluation tools that take into account not only the more technical aspects of design, such as energy efficiency and aspects of environmental comfort through simulation software, but also the more subjective aspects of design must be developed. The authors are working on several tools that consider local culture and ways in building and using schools. For a wider application such tools should serve similar situations and needs.

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Appendix of figures, captions and table

Figure 1: Example of a recent school building inaugurated in 2012 administrated by FDE in the State of São Paulo, Brazil (EE Vila Esperança, São Paulo, Copywrite © by Apiacás Arquitetura).
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Figure 2: A design process model (Source: authors)
Figure 3: Model of a recommended design process as indicated by the literature (Source: authors)

Figure 4: A model of the local school design process based on the process administered by FDE (Source: authors)
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A- Enriched reference material
B- Enriched architectural program
C- Participatory process
D- Multidisciplinary teams
E- Multiple assessment moments
F- Identification of site risk situations
G- Participation of experts during the design process
H- Commissioning
I- Post Occupation Evaluation
J- Retrofit
K- Feedback from local experiences

Figure 5A: Presence in % of characteristics found in the reference design process in comparison to the local school design process (Source: authors)

Figure 5B: Boxplot output relating data on procedures found in a reference design process and the experience or size of architectural firms.
Figure 6A: Design parameters or “patterns” from Nair et al. (2009) in % mentioned by professionals as criteria in their design process. (Source: authors)

Figure 6B: Boxplot output relating data on patterns used by architects of the sample and the experience or size of firms.
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Figure 7: Design parameters (% of occurring responses) mentioned by architects working for FDE (Source: authors)

Figure 8: Challenges (% of occurring responses) faced by designers in the FDE school design process (Source: authors)
**Figure 9:** Relation of pedagogy to design decisions as viewed by the sample of architects (% of occurring responses). (Source: authors)

**Figure 10:** Concerns in relation to functional requirements as viewed by the sample of architects (% of occurring responses). (Source: authors)
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Figure 11: Concerns in relation to environmental comfort as viewed by the sample of architects (% of occurring responses). (Source: authors)

Figure 12: Concerns in relation to costs and budget decisions as viewed by the sample of architects (% of occurring responses). (Source: authors)
Figure 13: Concerns in relation to security issues as viewed by the sample of architects (% of occurring responses). (Source: authors)

Figure 14: Concerns in relation to urban questions as viewed by the sample of architects (% of occurring responses). (Source: authors)
Figure 15: Concerns in relation to aesthetic questions as viewed by the sample of architects (% of occurring responses). (Source: authors)
Figure 16: Concerns in relation to sustainability as viewed by the sample of architects (% of occurring responses). (Source: authors)

Figure 17: Concerns in relation to questions of time and change over time as viewed by the sample of architects (% of occurring responses). (Source: authors)
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Figure 18: Evaluation on the possibility of introducing specific changes into the local state school design process as indicated by the sample architects (total number of answers for each possible change item). (Source: authors)

Figure 19: An improved design process (Source: authors)
Table 1: Evaluation by the architects interviewed about the possible changes that should be introduced to the school design process (% of occurring responses).

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<th>Neutral</th>
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