

IMPORTANCE OF LEARNING MODALITIES IN THE COMFORT OF SCHOOL ARCHITECTURE

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RESUMO

A configuração do edifício escolar é de grande importância para bons resultados dos processos de ensino-aprendizagem. A arquitetura deve fornecer, em primeiro lugar, ambientes de qualidade, com condições de conforto necessários para seus usuários, a fim de garantir um impacto positivo do ambiente nas pessoas. Para alcançar uma aprendizagem/ensino de qualidade, estudos sobre o ambiente apontam recomendações gerais para a arquitetura escolar, as quais devem dar suporte às Modalidades de Aprendizagem (MA). O objetivo do estudo é aplicar o conceito de Modalidades de Aprendizagem na ampliação da maneira como os estudos de APO avaliam edifícios escolares. A funcionalidade do espaço educacional é um dos aspectos essenciais ao Conforto Ambiental de escolas. Para tanto, dois métodos de pesquisa foram empregados: pesquisa bibliográfica e a tradução de conceitos educacionais e de projeto em representações gráficas que deem suporte ao processo de projeto criativo de edifícios escolares. Acredita-se que quanto mais rico é o ambiente escolar em permitir a diversidade e a inclusão de diversas atividades educacionais através das MAs, no que diz respeito ao desenvolvimento de novas habilidades, mais funcionais os espaços se tornam, oferecendo conforto que vai além dos três aspectos ambientais (térmico, acústico e lumínico). As representações gráficas resultantes mostram essa diversidade e abrem possibilidades para a forma com que os espaços escolares podem ser trabalhados, o que também pode ser observado quando realizadas APOs. Concluiu-se ser essencial se considerar as modalidades de aprendizagem entre os fatores de influência do projeto escolar e na posterior avaliação do edifício, por estas fortalecerem o Conforto Ambiental em relação à funcionalidade. A contribuição é essencialmente metodológica a fim de garantir um processo de projeto mais eficaz.

Palavras-chave: arquitetura escolar, modalidades de aprendizagem, funcionalidade, conforto ambiental

ABSTRACT

The physical school building setting is crucial for the productivity of learning-teaching processes. Architectural design's concern is primarily to provide quality environments with comfort conditions for users, to guarantee that the space impacts positively on people. To achieve a quality learning/teaching, environment studies have brought forward general recommendations for school architecture, and these should support the diverse Learning Modalities (LM). The main goal of the study is to apply the concept of Learning Modalities to broaden POE studies to assess school buildings. The educational function of space is considered an essential aspect of Environmental Comfort in schools. Two research methods were employed: a literature search and the translation of educational and design concepts into graphic representations that support the creative design process of school buildings. There is the assumption that the richer the school environment is in permitting diverse and inclusive educational activities through LMs, in terms of the development of different skills, the more functional spaces become, offering comfort in more than its three environmental aspects (thermal, acoustic and illumination). The graphic representations resulted show this diversity, open possibilities of how to work with school spaces and what also to look for in POEs. The conclusion regards the importance of considering learning modalities amongst the factors of influence on school design and building assessment, once those strengthen the Environmental Comfort regarding functionality. The contribution is essentially methodological, ensuring a more effective design process.

Keywords: school architecture, learning modalities, functionality, environmental comfort

1. INTRODUCTION

The physical school building setting is crucial for the productivity of learning-teaching processes. The quality of this environment has a considerable influence on this process and on the behaviour of users, especially students (TAYLOR, 2009; LEIRINGER e CARDELLINO, 2011; AZEVEDO, 2012; IMMS e BYERS, 2016). Students' achievement rates increase (BERGSAGEL et al., 2007; TAYLOR, 2009; FRANÇA, 2011; KOWALTOWSKI, 2011; LEIRINGER e CARDELLINO, 2011; BARRET *et al.*, 2016) when educational quality is high, and when spaces are appropriate to their needs, providing a feeling of comfort to perform activities (WALDEN, 2009).

Architectural design goals are primarily to provide quality environments with comfort conditions for users, to guarantee that the space affects positively on people. According to Walden (2009), this is true for school buildings as well. A precondition for successful learning is that students must feel as comfortable at school, as they would feel at home. Constructed, rebuilt or reformed, a number of factors influence school projects: practical and technological considerations, project trends related to public policies, availability of materials and techniques (WOOLNER, 2007). Nevertheless, Dudek (2000) and Taylor (2009) criticize educational constructions that mainly incorporate technical considerations - norms, square footage, energy efficiency - leaving behind aesthetic issues and other more complex discussions that also include creativity, imagination, and the functional aspect. The concern could also be focused on other design decisions, such as identity and context, implantation, considerations about the terrain and its exterior, characteristics associated to the concept of learning and pedagogy chosen, temporality and durability, and with a great importance, organization and functioning of the building. (DELIBERADOR, 2016)

Also, many ideas influence the design of buildings, from different groups of stakeholders, and directed to many users. However, individual expectations, although essential, cannot always be taken into consideration separately. To achieve a quality learning/teaching environment studies have brought forward general recommendations for school architecture and these should support multiple Learning Modalities (LM) established by educational theories and systems. The modalities are, on three scales: collective learning through exposition of facts, experiments and experiences; active/hands-on-work projects and group work (big or small) as well as individual activities, which require concentration (BERGSAGEL *et al.*, 2007). To support such modalities in the physical environment, Design Patterns are brought forward by Nair, Fielding and Lackney (2013). These work as open-ended guidelines for decision making in a design process. Design patterns are seen as important components in an architectural programme, and can act as fundamental pillars on the learning-teaching process.

The quality of the built environment (functional, aesthetic, environmental comfort, maintenance), can have positive or negative impacts on health, social interaction, behaviour, productivity, physical comfort and user satisfaction. In schools, these issues can interfere in educational processes; affect resources spent on the operation of a building and have environmental impacts (AZEVEDO, 2002; MUELLER, 2007). In this paper educational space and its functional quality is discussed as part of an important environmental comfort factor.

2. GOAL

The main goal of the study is to apply the concept of Learning Modalities to broaden POE studies do assess school buildings. The educational function of space is considered an essential aspect of Environmental Comfort in schools. Design Patterns should be established, based on Learning Modalities and feedback results from POEs of school buildings to instruct the architectural programme and design process.

3. METHOD

Two research methods are employed: a literature search and the translation of educational and design concepts into graphic representations that support the creative design process of school buildings. The concept of Learning Modalities is the basis of the study. There is the assumption that the richer the school environment in permitting diverse and inclusive educational activities through learning LMs, in terms of the development of different skills, the more functional spaces become, offering comfort in more than its three environmental (thermal, acoustic and illumination) aspects. The study focused on:

- 18 Learning Modalities proposed by Lippman (2003);
- Design Patterns presented by Nair, Fielding and Lackney (2013) and
- Multiple Intelligences to support the Learning Modalities and the need for diversified spaces;

- Environmental Comfort in Schools, focusing primarily on functional aspects;
- POE methods to support the development of an architectural programme and a creative design process;
- Translation of theoretical concept into graphic representations.

3.1. Learning Modalities and Environmental Comfort based on Functionality

Contemporary schools need to present the new design patterns (Table 1) and ensure that their spaces function effectively according to the demands of learning-teaching process and related activities, which are the learning modalities to be discussed in depth along the paper. To ensure that the effectiveness is met, it is crucial to evaluate the space, listening to users, noticing their level of satisfaction and what could be done to increase it.

Table 1 – Design Patterns from Nair, Fielding and Lackney (2009)

1. Classrooms, Learning Studios, Advisories and Small Learning Communities	16. Watering Hole Space
2. Welcoming Entry	17. Cave Space
3. Student Display Space	18. Design for Multiple Intelligences*
4. Home Base and Individual Storage	19. Daylighting
5. Science Labs, Arts Labs and Life Skills Areas	20. Natural Ventilation
6. Art, Music and Performance	21. Full Spectrum Lighting
7. Physical Fitness	22. Sustainable Elements and School as 3D Textbook
8. Casual Eating Areas	23. Local Signature
9. Transparency	24. Connected to the Community
10. Interior and Exterior Vistas	25. Home-like bathrooms
11. Dispersed Technology	26. Teachers as professionals
12. Indoor–Outdoor Connection	27. Shared learning resources and library
13. Soft Seating	28. Safety and security
14. Flexible Spaces	29. Bringing It All Together
15. Campfire Space	

*There are eight intelligences: verbal-linguistic, logical-mathematical, musical, bodily-kinaesthetic, visual-spatial, naturalist, interpersonal, intrapersonal.

Specifically when it comes to educational spaces, the individuality of students must be taken into account, regarding the multiple intelligences (MI). In 1999, Gibson and Govendo postulated that teachers, especially at the high school level, explore MI in the classroom, with the mission of preparing students for the various roles, experiences and opportunities they would face in the "real world" of the XXI century. Although the intelligences are strongly related to curriculum, the space and its functionality have an undoubted influence over its outcomes.

The Learning Modalities concept considers this multiplicity of activities required by the intelligences, and therefore they organize the design of space. Lippman (2003) advocates that a good school project should accommodate as many modalities as possible, replacing the old spaces that serve a restricted number of possibilities by those which attend several, reiterating the need for diversity. Each activity requires a different organization of space or, in some cases, even spaces exclusively dedicated to them. In this way, different learning styles and the learning modalities are also intrinsically linked to how the space is designed, which is related to the function it supports. This will allow the performance of activities in the best way possible, increasing user comfort.

Pearlman (2011) demonstrates that collaborative projects, seminars, workshops can be accommodated in the same space as other types of work, which shows that depending on the Learning Modalities wanted, the architectural programme can stimulate countless design solutions. In some cases, activities require from their environment specific features, like experiments that have to be developed in a laboratory, or the work with music, theatre or recordings that demand classrooms acoustically treated, for example. However, these

specificities do not detract the multiplicity of the school, but corroborates with a desired diversity. Designers, therefore, can work with the Design Patterns to create appropriate environments to host each and all of these activities, in a versatile way, creating a set of spaces – studios, plazas, multipurpose classrooms, home bases or breakout areas – that will be used fully, or other to be used in specific situations.

Environmental comfort can be achieved in terms of functionality in several ways, when taking into consideration Learning Modalities and Design Patterns. Starting with flexibility (described as one of the desired Design Patterns), which will allow constant change of space with a lack of barriers, but also in terms of flooring (thinking about the type of activity) that will support storytelling, social-emotional learning, for example. Besides that, finishes are also crucial (according to purposes), ceilings, walls (paints and coatings), casework and furnishings (as the soft seating pointed out in another Design Pattern). Even computers and office equipment (dispersed technology), and other specialties like lockers, and toilet partitions are described outlined in Design Patterns (GELFAND, 2010).

3.2. Considering Learning Modalities in POE, architectural programme and design process

To provide for diverse environments within a school, whether in a renovation project or in a new school design, architects need to have in mind one of those two aspects, highlighted as follow. First is the specific demand of a place and its users, in case of a renovation project: What works in that context and what does not must be evaluated. Second, now considering new designs, are the general demands of 21st century schools, based on learning modalities and design patterns, must be given priority

In both cases, the feedback process that POE provides is vital, to understand the reality, which means that positive and negative characteristics, environmental comfort and relations between human behaviour and built environment should be investigated (ORNSTEIN, 2005; ORNSTEIN *et al.*, 2009; TAYLOR, 2009). With the results in hands, it is possible to see what has to be changed or which new features that have be added, or if something is actually working effectively and should be kept that way.

Nevertheless, it is noted that some of the architects' choices regarding the elements that will work with concern, especially in public schools, very specific baselines, followed by a restricted design time. This is the case of the projects from FDE (Fundação para o Desenvolvimento da Educação) at the state of São Paulo in Brazil, which start from an architectural program shaped by standardization in function of classrooms and minimum dimensions, environmental requirements, installations and components (such as windows and doors) (GRAÇA, 2002).

In this way, the choices are limited to pre-set specifications in a relatively rigid form that does not give much space for change in the architectural programme, which should be based on POE undertaken in former projects (process showed in **Figure 1**). Although some changes have been made during the years in FDE projects, and the recognition of their attempt to use some information from previous designs in the next ones, currently specifically in terms of acoustics, other aspects do not get as much attention, especially functionality.

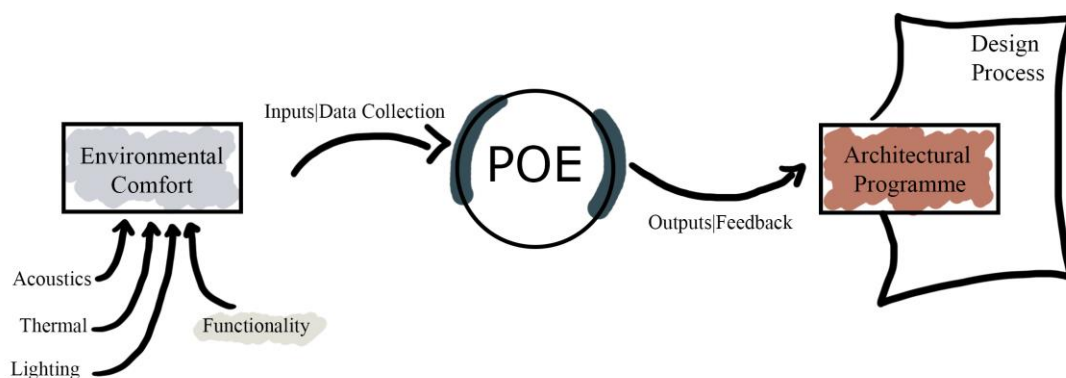


Figure 1 – Process considering inputs and outputs in POE, highlighting functionality aspect.

In the design process, according to Moreira (2007), formulation and verification of several hypotheses for solving the problem(s) are performed. In the development of the process, there are anticipations of events so that adequate solutions can be found from the proposition of elements that have the function of accomplishing specific objectives. Once functionality is put as one of the objectives of architecture, and there is a keen interest on promoting comfort and well-being in terms of multiple possibilities to perform activities

and easiness on doing so, this will be taken into consideration on the design process, starting by the programme.

In order to find more appropriate solutions it is necessary to collect data that will help in the proposition of the model, in a process which stages are analysis, synthesis and evaluation. Considering specifically functionality, then, the data required needs to be related to Learning Modalities demanded by pedagogy used (or in general, what is recommended for 21st century schools based on multiple intelligences).

The architectural program, in turn, has as its objective the description of the context in which the project will operate, being an analytical stage of the design process (MOREIRA, 2007). As one of the first stages of this process, it precedes the project itself and establishes the problem that will be answered by the form by dividing the context into parts. In order to avoid suggesting or imposing solutions, the program "[...] must confine itself to describing the context or the general aspects of the form ..." (KOWALTOWSKI and MOREIRA, 2011).

In the development of the program, the user is seen as an active element and the idea generation must be focused on it in order to establish the needs, goals and guidelines that the form will fulfil. Hence, not only physical, but also psychological and cultural characteristics are identified, as well as the activities that will be performed and the values of that user. According to Deliberador (2016), the more complete this stage is, the chance of reworking in later phases decreases in an inversely proportional character. Therefore, the space will function more effectively.

4. RESULTS AND DISCUSSION

In order to better visualize the application and what it means to use Learning Modalities as a support for thinking in functionality and, therefore, Environmental Comfort of the built environment, graphic representation of it was done as shown by (Table 2). The sketches show both the possible disposition of people and how they are related to each other in each modality, as well as ideas of how could the space be, thus related to what can be considered when undertaking a POE and, further the construction of an architecture programme.

Together with the Learning Modalities representation, a correlation between Multiple Intelligences and the former was also developed (Table 3), once it is considered that the more the intelligences are understood and thought about in a design process, the more the places will function towards supporting them.

As it is possible to perceive on Table 2, some Learning Modalities could even happen at the same place, but in different times, depending on the level of concentration required. As an example it is possible to mention modalities 2 (peer tutoring) and 3 (team collaborative work), that can even happen at the same time, as well as 1 (independent study) and 4 (one-on-one learning with teacher). Places to support those specific modalities, for example, can be thought as a proper place for the development of verbal-linguistic, logical-mathematical intelligences, or musical and bodily-kinaesthetic ones.

It is also possible to comprehend by analysing the sketches if walls, floors or even ceilings will be needed and how they should be, if the walls should be static, for example. If it should allow opening and closing for activities with more or less people, or even to connect inside and outside areas for a naturalist learning (modality 14), or even for performances and music-based learning (modality 11) to take place.

Table 3, in the third column, also shows the kind of activities people with each intelligence should engage in, or could be engaged with so their skills are better developed. This gives a fair notion of what the school design could bring in order to answer those needs, providing rich environments where people would feel more comfortable, seeking to give adequate solutions both for each group of people, but also regarding each individual.

Table 2 - 18 learning modalities, according to Lippman (2003), and interpreted by the author.


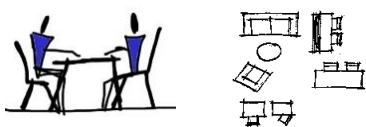


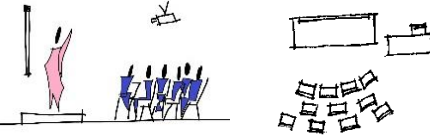
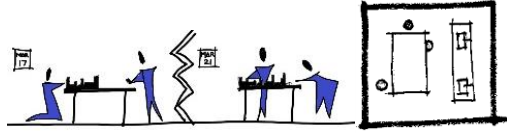


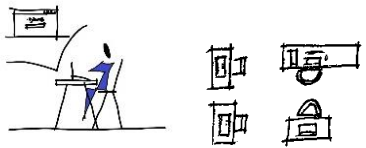
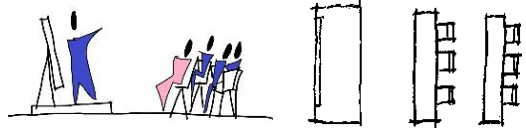

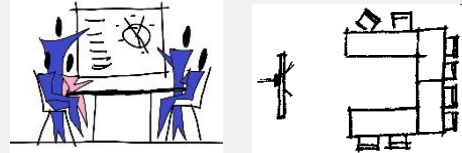






<p>1. Independent study</p> 	<p>2. Peer tutoring</p> 
<p>3. Team collaborative work in small and mid-size groups (3–6 students)</p> 	<p>4. One-on-one learning with the teacher</p> 
<p>5. Lecture format with the teacher or outside expert at centre stage</p> 	<p>6. Project-based learning</p> 
<p>7. Technology-based learning with mobile computers</p> 	<p>8. Distance learning</p> 
<p>9. Research via the Internet with wireless networking</p> 	<p>10. Student presentations</p> 
<p>11. Performance and music-based learning</p> 	<p>12. Seminar-style instruction</p> 
<p>13. Collaborative and interdisciplinary learning</p> 	<p>14. Naturalist learning</p> 
<p>15. Social/emotional learning</p> 	<p>16. Art-based learning</p> 
<p>17. Storytelling (floor seating)</p> 	<p>18. Learning by building—hands on learning</p> 

Table 3 - Learning styles: relation between Multiple Intelligences and Learning Modalities.

MI	Characteristics of students	Students' needs	Relation with Learning Modalities
Verbal-linguistic	They think in words and are interested in reading, writing, storytelling, theoretical-based research.	Activities with books, places for typing, writing materials, notebooks, discussions.	Can happen through the modalities 1, 2, 3, 4, 9, 10.
Logical-mathematical	They think by reason and are interested in experiments, questionings, logic activities as puzzles, calculations.	Work with materials for manipulation and experiments in science and other projects, visits to planetariums, science museums.	Can happen through the modalities 1, 2, 3, 4, 6, 7, 9, 13.
Musical	They think by rhythms and melodies and are interested in singing, playing something or beating hands and feet, listening.	Singing activities, attending concerts, learning with instruments.	Can happen through the modalities 1, 2, 3, 4, 6, 8, 9, 10, 11.
Bodily-Kinaesthetic	They think through sensations and are interested in dances, races, construction, expressions by gestures.	Activities involving theatrical presentations, movement, manual projects, construction of elements, sports.	Can happen through the modalities 1, 2, 3, 4, 6, 10, 11, 13.
Visual-spatial	They think by pictures and are interested in drawings, design.	Work with arts, Legos, videos, games of imagination, visits to art museums.	Can happen through the modalities 1, 2, 3, 4, 7, 9, 16
Interpersonal	They think through considerations of other people's ideas and are interested in organizing activities, leading teams, creating relationships, mediations.	Works involving people, group games, meetings, community events, mentoring programmes.	Can happen through the modalities 2, 3, 6, 13.
Intrapersonal	They think through their feelings and personal goals and are interested in setting goals, meditation, planning, and reflection.	Work that happen in niches, individually, personal choices.	Can happen through the modalities 1, 4, 7, 9, 15.
Naturalist	They think through nature and are interested in animals, gardening, nature investigations, and environmental care.	Activities that involve contact with nature, interaction with animals and tools for research and observation of nature	Can happen through the modalities 1, 2, 3, 4, 6, 9, 13, 14.

*The table was developed based on the information from Armstrong (2009)

5. CONCLUSION

In the development of a project, the architect seeks to provide spaces that make his occupants feel comfortable and "at home" in a way, so that the influence of these environments on people is positive. In public places, attending to this aspect becomes more difficult by the number of different people who use them, with different perceptions and preferences (WALDEN, 2009).

The solutions regarding Environmental Comfort are deeply connected to the activities happening, and regarding the number of people using the space, frequency, duration, type of activities. With the functionality aspect is not different, and the Learning Modalities can help the comprehension of how the space should be shaped. POE, in turn, can be a helpful way to understand all the nuances of what happens at the place, always considering the multiple possibilities of activities and regarding the need of comfort to develop them all, and to change from one to another.

As pointed out by Woolner (2007), a number of factors influence school projects (practical and technological considerations, public policies, material and technics), nonetheless, advocate Dudek (2000) and Taylor (2009), the qualitative standards for an architecture that supports school functioning and learning that occurs in it, are not necessarily related to codes and specifications, although the importance of these is indisputable. Deliberador (2016) agrees with this statement, understanding that design decisions should also be focused on aspects as identity, context, characteristics related to the concepts of learning and pedagogy, amongst others.

This paper endorses the value of taking into consideration the learning modalities as one of the key aspects of design decisions, as well as on the assessment of school architecture. By working with the learning modalities, alongside with the new design patterns and multiple intelligences, more flexible and adaptable spaces will be taken into consideration since the architectural programme, and, hence the environmental comfort related to functionality, will be increased, which will improve [specially] pupils satisfaction and social interaction, physical comfort, and even attendance and attainment. Another contribution is methodological: the graphic representation developed as an important way to stimulate a more effective and creative process of the architect, once there will be a general guidance towards functional school buildings.

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ACKNOWLEDGMENT

The authors thank FAPESP for financing the Project.