Cooperative Education: The Physical Environment

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Abstract - **According to the Report Jacques Delors, education in the 21st century will be supported over four pillars. It is expected for the students: to learn how to acquire knowledge, to learn how to realize, to learn how to socialize and to learn how to be. The learning of how to acquire knowledge has been the main objective of the conventional education and in a minor fashion, the learning of how to realize. Thus the learning of how to socialize and how to be, and also the laerning of how to deal with behavioural matters requires new educational models. The motivation and the physical environment make the scenario suitable for engineering education. Cooperative Education is an education model that presents an alternation of Academic Periods at the university and Work Term Periods (Internship programs) in corporations. That model mixes learning and professional experience acquired by the students in corporations, research institutes and social projects. This paper presents the way some physical classroom environments and the Cooperative education model can play influence over the learning of the engineering students.**

Index Terms - Cooperative Education, Physical Environment, Engineering Education, Internship.

INTRODUCTION

The word education usually is associated with a qualification, a certification, a diploma, a piece of paper when the students conclude a course. The word education, in its more holistic direction, beyond a good formation, also gains to the individual a behavior. The new paradigms of a market of work in constant transformations come in search of abilities, that is, of a set of knowledge, abilities and attitudes. Within this scene, the study of the elements that influence the behavior of the individual is a preponderant factor in the definition of the formative process of the new professionals.

The Report Jacques Delors, published in Brazil as "Education - a treasure to discover" [1], was elaborated with the objective of showing the changes that will have to occur in education, through new processes of learning that should follow the speed and the amount of information disponibilized in the communiction medias. This report concludes that the education will have to be organized on four pillars:

1. to learn how to know: to acquire the instruments for understanding.
2. To learn how to make: to be able to act over the environment.
3. To learn how to coexist: to be able to socialize and to practice cooperative activities.
4. To learn how to be - by integrating the former three: to know, to make and to coexist.

The learning of how to acquire knowledge has been the main objective of conventional education and in a lesser scale, increased of learning of how to accomplish. The learning of how to coexist and the learning of how to be, require new education models. The motivation and the physical environment form the scene suitable for the engineering education.

The study of the influence of the environment in the behavior of people has been the object of research in the areas of psychology that deal with the scientific study of the relations beteween men and their environment. The word environment, represents a broad and inexact concept. It was adopted by the British, without alterations for the English language, from the French word *environ* that means to form a ring in lathe, to encircle, to surround and the suffix *ment* the result or product of the verb. The word environment specifically means 'what it encircles, the conditions or influences where any person lives or if it develops'.

Reference [2] considers that the environmental psychology deals with all the concepts created by men to represent the space; the study of the answers seek by manhood to the standards of stimulations experienced by the people if they can move themselves selectively in the existing intervals between the desired or the adverse objects.

Reference [3] appraises that the environmental psychology studies the transaction between the physical individuals and their environments. In these transactions, the individuals change the environment and as well as their behavior is changed by the environment. Environmental psychology includes the research and the practice directed towards making the constructions more humanized and to improve our relationship with the natural environment.

The architecture of the physical space destined to the learning exerts its more powerful influence on the behavior in an indirect way, promoting specific forms of social organization. In none another place this is more evident than in the physical spaces destined to the educational intentions. The way we act on our environment and we perceive the consequences of our actions, is decisive to learn how to coexist and to learn how to be.

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COOPERATIVE EDUCATION

According to [4], in order to explore aptitudes and to discover vocations, the students must know the areas of work, their requirements and what is expected for them to accomplish as presented on Table 1.

TABLE 1 - APTITUDES AND VOCATIONS

To know	how to explore aptitudes and to discover vocations
the interests	to supply the individuals the opportunity to know and to try different areas of work in order to discover their interests and aptitudes.
how to be	to allow the individuals to immediately learn the requirements of certain occupations and the possibilities to accomplish them through practical activities.
how to coexist	to show to the individuals what is expected in relation to determined types of activities, daily duties, people with they will be forced to coexist and the degree competitiveness to be awaited.

Learning is considered as being a relatively permanent change in the behavior of the individuals, which happens as a result of a practical experience.

Reference [5] considers 5 hypotheses for the process of learning based on the individuals's experiences and practical experiences. Table 2 presents the hypotheses of the andragogy (adult education)

TABLE 2 - HYPOTHESES OF THE ANDRAGOGY

Hypotheses	*ANDRAGOGY*
Autonomy	To develop the capacity to take proper decisions
Experience	To produce the base for the learning of new concepts from the experiences.
Promptitude for the learning	Promptitude for learning: in a pragmatic way, to learn what it is related with real situations in life.
Application of the learning	To develop the vision of the future for the learning of what they believed to be necessary, through the learning based on problems and not only centered in knowledge.
Motivation To learn	To develop intrinsic interests, that is, personal associations to values and objectives, instead of associating the results of learning with the external compensations.

Cooperative education is an education model that promotes the systematic learning through lessons and learning based on work situations. The model integrates the companies and the institutions of education in the formation of qualified professionals that face the dynamism of the work market, which demands the fast adequacy of function and up to date knowledge together with technological innovations [6].

The quarterly school calendar practised at the Cooperative courses is divided into three periods: January to April, May to August and September to December. Academic periods (A1 to A9) of classes are alternated with periods of practical professional Internship programs in companies (I 1 to I6). The Cooperative structure is presented on Table 3.

TABLE 3 – COOPERATIVE QUARTERLY STRUCTURE

Scheme of the Cooperative courses												
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
1st year	**A 1**				**A 2**				**I 1**			
2nd year	**A 3**				**I 2**				**A 4**			
3rd year	**I 3**				**A 5**				**I 4**			
4th year	**A 6**				**I 5**				**A 7**			
5th year	**I 6**				**A 8**				**A 9**			
Classrooms	**3**				**3**				**3**			
Interships	**2**				**2**				**2**			

The Cooperative model structure requires 3 classrooms while in the semester system 5 classrooms are needed That means a reduction in resources such as: libraries, computers, project rooms, laboratories, books, parking areas, i.e., resources for 3 instead of 5 groups of students. At the end of the course, the students have accomplished 24 months of Internship activities exerting diverse functions in different companies, departments, and research institutes, meaning a professional résumé of 2 years in the work market associated with the academic diploma, increasing their ability and areas of performance. Since the Internship periods are carried within exclusive periods, they can be accomplished in different cities or countries allowing the students to experience different realities and cultures. With whole dedication, the students can assume valuable activities with responsibility, and increase their insertion into the work market. Through the Internship agreements, the education institution is able to increase its action and to scatter abroad other issues such as patents, research and extension activities and technological solutions.

THE PHYSICAL ENVIROMENT

The word space (environment) means: region with one, two or three dimensions, said respectively: extension, surface and volume, inside of which a point is locate or a indefinite extension or a delimited place that can contain something. In the educational environment inserted in the social bounds and also within the human relations, the education methodology will have to be structuralized and to be planned in order to attend to the future which, beyond the learning of how to do and how to know, also requires the learning of how to coexist and how to be.

According to [7] the buildings are constructed for people; while some people only contemplate them, others live and work in them. The schools, hospitals and residence buildings can be beautiful for the eyes, but sometimes very complicated for those who live in them, when their

functions are not properly defined. The author considers that the way as we act on our environment and we perceive the consequences of our actions can be decisive for our survival as species. The architecture within its origins and affinities based on painting and sculpture is adequate for the construction of buildings and monuments. In the planning of the spaces with strong deterministic environment it is assumed that people's lives can be influenced by the decisions planned on the environment, therefore it could make use and distribute the units and control priorities. In such a way, the environmental psychologists are willing to offer a level of planning, as much or superior to that offered by the architects. That opens a field of research concerning the physical environment and its relation with learning as belonging to the field of environmental psychology.

RELATION BETWEEN THE PHYSICAL SPACE AND LEARNING

According to [8], the task of the environmental psychologists who study the apprenticement is to identify the conditions under which the physical and the non-physical elements are arranged, resulting in an improvement of the learning. Reference [3] consider that the effect of the physical space on the learning must be analyzed under four dimensions: the proper learning, feelings with regard to the learning, the social behavior related to the learning and the aspects of health and stress of the learning. In those analyses, the environmental psychologists employ four referring premises to the learning and to the physical environment: that they do not exert a direct influence, that they are not universal, that does not exist one specific better physical arrangement, but the arrangement is important in the process of education and learning. Table 4 presents the four premisses staded by [3].

TABLE 4 - PREMISES OF [3]

Physical environment and learning	
a	The physical arrangement does not influence directly, but it can facilitate learning or to make it difficult in a symbolic and directed form. For example: extreme noises intervene with the attention of the classroom and a badly organized classroom can repass to the apprentices the impression of that the professors and the schools are not worried about their progresses.
b	The effects of the physical arrangements on the learning are not universal, but they are regulated by the social context and also by the academic program.
c	An optimum physical arrangement for the apprenticement does not exist. The best arrangements are those coherent with the program contents concerning what is being learned, with the objectives of the classroom and the characteristics of the apprentices.
d	The apprenticement is maximized when the physical arrangement is considered in a very careful way as much as other aspects of the learning situation such as the ability of the professor and the structure of the courses.

According to [9], the relations person/environment to be considered in the apprenticement are:

- the **personal characteristics** of the students (pertaining to school attitudes in relation to the learning, age, personality, sex, previous experiences);
- the interaction with the **layout of the learning space** (size, noise, population density and disposal of the furniture);
- the surroundings of the **social organizational environment** (rules, education methodology , educational orientation);
- the production of **attitudes** related with the learning (satisfaction with the school, dissatisfaction with the class, commitment with the learning)
- **behavior** (participation of the class, attention with the learning materials, questionings, pro-active attitude or non-persistence, creativity, apprenticement and performance).

THE SIZE OF THE SCHOOLS

The school dimensions, associated with the demand for students, seem to define that they will have to be as big as possible in the great urban centers and dispersed in the remaining places. It was not possible to find registers concerning the definition of the optimum dimensions of a school campus through criteria such as the students's academic performance or social parameters, because the economics scale in the provision of the number of professors, installations as laboratories, auditorium, workshops and libraries. Many experiences of learning are affected by the school dimensions, which are frequently associated with the non-ideal conditions with regard to time in space. Students in big schools have interests in a variety of subjects, but their time in the school is limited, in such a way that they do not really participate in activities as much as the students of small schools do.

THE SPACE OF ACTION

The shape and the disposal of the furniture of the classroom form a symbolic dimension that influences the attitudes of the professors and the students. This disposal is accented with the raised floor and the differentiation of the type and size of the desk, reiterating an authoritarian understanding of the professor in detriment of a comprehensive and cooperative understanding.

According to [9]. the traditional disposition of the classroom – desks in straight rows in front of the professors - could not be the best way to promote involvement and satisfaction of the students, for a series of reasons: (1) the students sitting in the front rows can block the vision on the professor and the blackboard; (2) the students in the back rows are isolated and could not pay attention to the subjects

taught; (3) the visual and auditory communication in interactive activities with the students could be prejudiced; (4) the dominator role of the professors is accented by the use of a different furniture as well as their distance and position with regard to the students; (5) the disposal in rows inhibits the learning methodologies based in groups and in action.

In a study accomplished by [10], six types of classrooms were considered: those with the desks disposed in lines, with tables for group activities, in the shape of a laboratory, in a circular disposition, without windows and with partition walls with glass windows. The comments made by the students indicated that during the regular classes (desks in lines) there was a bigger average participation in discussions. However, the absolute number of affirmations for the question was higher in the classes disposed in a circular form. The students also declared not to like either laboratory classes or rooms without windows. The author [11] carried an experiment in a traditional, rectangular shape classroom having the professor's desk at the center and students's desks in rows. The position of the students and the number of their participation were recorded. The central and the front regions where statistically presented the biggest participation of the students, is called the zone of action. The results attained are presented on Figure 1.

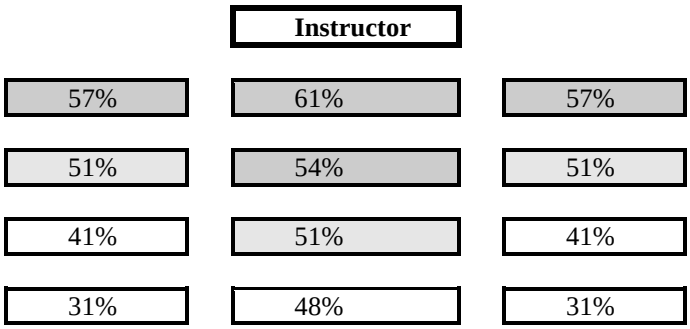

FIGURE 3 – THE ZONE OF ACTION

Although the position in the classroom is important, the research demonstrated that the good students increased their participation when they are placed in the action zone. The students with learning problems did not demonstrate improvement even when they were placed the action zone, although a relative increase in the participation could be observed. Even though the action zone increases the number of participations, the position is not necessarily associated with an increase in the evaluation and performance of the student. Perhaps this could be explained by the daily inclination of the students who choose the action zone to participate of the lessons and feel more responsible concerning the school activities. It seems to indicate that the space relation in the efficiency of the students has a personal participation and deserves a discerning study. The physical changes in the learning space as a whole, affect the school performance. Factors as: color, noise, temperature, illumination and odor, influence the environmental comfort of the classrooms.

THE CLASSROOM AND THE BEHAVIOR

For the professors, researchers and administrators, the classroom always was a subject of interest. Such interest has been growing substantially with the new concepts as the modular planning and the open classroom, with very well defined goals defined that aim the development of the quality of the educational experience. However, not always an effective attention to the physical space of the classroom has been paid, as integrant part of the educational process. Most of the time, the environment of the classroom is modified to promote some behavioral objective, for example to intensify the level of debate or to promote the work in groups.

For the researchers it is interesting to observe, in case that some behavioral alteration has occurred, if it had to with the new education technique or if possibly it was caused by the disposal of the furniture in a more useful form aiming the relationship professor-student. In the analysis of the physical variables of the rooms the individual factors are important because all individuals have characteristics in some degree that influence their interaction with the physical properties of a room, as well as with people in the room. Those individual variables compose a series of different sources. The attitude of a person towards the social and physical function of a room can be the result of its experience lived in that room or in a similar one.

According to [9], an innovative professor decided to change the traditional straight rows in his classroom by a disposal in semicircles. His students did not like the new disposal. Apparently, their experiences in conventional classrooms contributed for the development of attitudes related to the disposal of a classroom. The results of the study reported by [12] concerning the perceptions of a distorted room also reflect the effect of former associations on the experiences or concepts of an individual. The social learning of a certain individual is an equally important determination factor of its behavior in some environments and will tend to excite the behavior that is expected in a specific situation. Some individual factors, such as the need for privacy, are not easily influenced by former experiences. These are universal variables that approximately determine certain aspects of the social behavior in all the social and environmental contexts. Two of those variables are the necessity to establish a territory for the preservation of the individual personal space.

THE SPACE FOR EDUCATION AND THE LEARNING

A Master is not who always teaches, but who suddenly learns (Guimarães Rosa).

Some individuals are born professors and possess the gift to create interest in the students and to analyze their learning process. Everyone, of course, can learn naturally when dealing with groups of students, increasing the attention degree and understanding the ways on which the groups operate and learn to observe.

It is important to consider that the main attribute in the "professor's function" is to develop sensitivity enough to be

aware of the verbal and not verbal interactions of the group and to pay attention to what occurs in the classroom with regard to: jokes, critics, laughs and commentaries. The professor should also be aware of the satisfaction signals. The identification of the natural leaders within the groups also assists the construction of the relationship and the communication as auxiliary potential monitors in each group of students.

The professor must be concerned about the personal development of each apprentice with regard to the challenges considered for the group. The necessities of the apprentices must be prioritized in a way that they do not fear the critics or even, the critics do not exist, to prevent the exclusion of this apprentice of the group. The professor should also be aware of the pressures and allow that all participants can practice their abilities and express their points of view to the other members of the group. The group members must be capable to try, to practice and to explore their own concepts.

The professor should not encourage or try to discourage some interactions unrelated to the tasks to be fulfilled, but that come to discourage the group. It is not an easy task to balance the actions, when the members of the group desire to engage themselves in subjects other than those concerned with learning. In that case the groups should be split into sub-groups.

The professors can encourage the effective learning in the classroom in some ways: they must help the group of students by stimulating the individual apprentices to participate as members of a group; to effect frequent exchanges of the face to face nteractions, when some emotional involvement is observed. People who never have anything to share will not become part of a group. Students who come to the classroom and enter without saying anything, and just wait for the professor to initiate the lesson, with a coldness that suggests a lack of emotional commitment, will remain as a collection of individual apprentices. The professor's equanimous domain of the group also will not aid. Without an effective sharing of tasks and the sense to carry through, the apprentices will remain inadvertent and very little integrated [13]. Concerning the function to produce a propitious environment for the work in groups, the disposal of the furniture is a preponderant factor.

TO TRANSFORM "CELLS" INTO EDUCATION CELLS

Whenever a room is fixed to promote a definitive specific type of behavior, it would have to be projected for that purpose, which would be to facilitate the learning of the student. The purpose of the physical space has a significant importance on the influence of the behavior. The type of influence on the students's behavior depends on the structure, the disposal and the architecture for which is designated, for a lecture room audience, a chemical laboratory or only a small room or seminaries. Moreover, the form, the furniture and determined ambient conditions also affect the behavior.

In order to attend to the purposes of education, the professors' offices are places that should be reformulated. The education institutions exist mainly to teach, to exchange information and mainly for the other objectives that seem to have been forgotten, whose absence explains the lack of interest of the students for it and whose presence develops the interest and the motivation for it [14].

It should be remembered that the architecture employed to built professors's offices and that keeps them isolated from their students and to those who defend it that the new goals of the educational process go beyond the learning of how to know and how to make; it extends to the learning of to how to coexist and how to be. The cells where hermit monks were confined in the monasteries, copying, mixing and translating old texts in agreement with the rules of the church practically do not exist any more. Those that persist, hinder the advance that the education will have to assume to guarantee its existence, relegating it to be in the edge of time and side by side with the Episcopal schools.

In many institutions rooms are transformed into true offices with a secretary or an automatic door in the entrance. The professors' offices are transformed into true "cells", isolating them from the students. The layout of the physical spaces destined to education and the learning of how to coexist and the learning of how to be, will have to be constructed to facilitate the work of the professors in the developing of the social behaviors.

INDIVIDUALITY AND TERRITORIALITY

According to [10], the individual space can be conceived as a wrap, that delimits "a portable" border. In a certain way, this personal space is a social one because its existence is only observed when a person introduces himself (or herself) inadvertently or intentionally into the personal space of another individual.

This phenomenon is usually observed when a person seated alone, for instance on a garden bench, and another one comes close and seats to the side, automatically the first person will show a disturbance signal and will move away from the other individual. The necessities to delimit the personal boundaries have been shown to be different within the various cultures.

Depending on the social situation, the personal space is also diversified. For instance, the limits for close friends differ from those imposed for strangers. The necessities for personal space appear in a variety of ways such as in large groups. If the reason for the formation of a group or a crowd is common (for example: to travel in the subway train or to wait in a line) the personal limits certainly are broken.

To coexist is related to others as: to invite, to be invitingly, to be attractive, invitation, guest, an individual that inhabits in a close place. One of the professor's main tasks in the undergraduate courses should be to lead the students to learn how to coexist. The professors should take into account the layout of their own offices. There are reports of room and office layouts that separate the personal spaces of the professors through the elements that isolate the visibility and acoustic. There is also a social isolation among professors.

In a general way, in the first period of training the thick partition walls that separate a room from another will have

to provide at least the visual contact, substituting the "walls" for transparent nareials. This visual contact should break some barriers that separate the personal spaces and provide a first period of training for the coexistence, even though some individuals insist on the installation of blinds in order to remain isolated. According to [10] the territoriality is another aspect of the human space behavior that is frequently difficult to be separated from the maintenance of the personal space. An individual demarcates a certain territory, using existing aspects of its environment or through the modification of the environment in order to establish markings or limits. Those boundary lines are understood and respected by the other individuals. That behavior is surprisingly similar to the one of the inferior animals. The territoriality for the research activities such as education requires of the professor a space adjusted for the function of being a professor.

Among the diverse characteristics that compose a room, whether fixed or changeable, certainly the size and the form constitute the most rigid ones. This way, the designers are mostly concerned with the work to manipulate other aspects of the classroom environment, such as the color, luminosity, room temperature and the disposal of the furniture. Most of the time, if the classroom environment is modified, the alteration is accomplished in order to promote some behavioral objective, for example, to increase the level of discussion or the work group. Studies have demonstrated that the relation professor/student is a preponderant factor, but some education techniques require special layouts.

CONCLUSION

Probably, the first attempt to evaluate the impact of the physical environment on the behavior outside of the laboratories had been the inquiries of Hawthorne in the decade of 1920. In a period of economic crisis, all attempts to use the environment and other aspects of the work conditions, as a form to maximize the productivity, were considered. The manipulation of the illumination levels and a variety of other modifications of the work conditions were applied. Due to the context and a variety of other aspects, it was not a surprise that the inquiries had shown that the social environment had more influence on the behavior than the physical environment. In part, due to the evidence and on the other hand because of other developments in applied psychology, the concern with the psychological effects of the environment was abandoned by the psychologists and turned to be attributed to the engineers and architects

With the advance of the communication medias and the competences being faced in a pragmatic way and directed towards the productive market, education will be required to teach how to coexist and how to be.

Many times the professor's offices are in a better shape than the classrooms where the students spend most of their time. The conception of the physical space will have to promote the group work and an interaction between the person who orientates and the students, a symbiosis between the professor's offices and the classrooms, transforming "cells" into education cells. This space must adjust the research task to the one of education, integrating graduation with post-graduation, preventing isolation of the person who orientates and students transforming a simple environment into an effective organic environment.

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