

## Cooperative Education

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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 learning of how to deal with behavioral matters require new educational models. Cooperative Education is an education model that presents an alternation of Academic Periods at the university and Work Term Periods (Internship programs) in corporations. Andragogy, from the Greek words Andros Agein Logos which mean, respectively, man conduct science is based on a principle that many problems originated in higher education result from not considering the age of the group of students which is above the one to whom the pedagogy appropriated for children is applied (from the Greek: paidós which means child, agein, to conduct logos, science).*

**Keywords:** *Andragogy, Cooperative Education, Internship, Work Term, Engineering Education.*

### 1. Andragogy

At the end of the 20th century, a UNESCO commission issued a report on the new routes of Education in the 21st century due to the promptness of the communication means at availing an immense amount of information, thus imposing deep changes in the teaching methodology. The Jacques Delors Report concludes that education should be organized on four pillars upon which the students may:

1. Learn how to know - to acquire tools for understanding;
2. Learn how to do – to be able to act on their environment;
3. Learn how to be sociable– to socialize and develop cooperative activities;
4. Learn how to be – to aggregate the three previously mentioned aspects:

to know, to do and to socialize.

In the conventional teaching one learns how to know and, in a lesser scale one learns how to do. The other two learning were not taken into consideration and comprise behavioral problems, which require new teaching methodologies.

Educators such as Malcolm Knowles, Pierre Furter, among others, associate the term andragogy with adult education. The reason for the use of this new methodology in college, Andragogy, from the Greek words *Andros Agein Logos* which mean, respectively, *man conduct science* is based on a principle that many problems originated in college education result from not considering the age of the group of college students which is above the one to whom the pedagogy appropriated for children is applied (from the Greek: *paidós* which means child, *agein*, to conduct *logos*, science). Table 1 presents a comparison between pedagogy and andragogy.

**Table 1. Pedagogy X Andragogy [CAVALCANTI, 2005]**

PREMISES	MODEL	
	PEDAGOGICAL	ANDRAGOGICAL
<b>Need to Know</b>	Children learn without questioning and not knowing the use of what the teacher teaches.	The adults know their needs and, in a pragmatic way pursue knowledge according to their needs.
<b>The Learner's Self Concept</b>	The learners depend on the teacher. The system affects their self esteem and depresses them as their skills are put in doubt.	The adults act independently, with autonomy and they feel able to learn and acquire knowledge they need even without the teacher's help.
<b>The Learner's Role</b>	The learner's experience is not valued but the teacher's and other scholars are. The learners are supposed to read, listen to, and do the schoolwork and homework.	The adult learners' experience is of paramount importance. The teacher's and other scholars' experience only serve as a reference source, which may or may not be valued by the student.
<b>Readiness to Learn</b>	The learners are always ready to learn whatever the teacher wants them to in order to pass the exams.	The adult learners are ready to learn whatever they want to learn that is meaningful to their needs.
<b>Learning Guidance</b>	The learners are oriented to learn subjects with specific contents that are deemed necessary in the future, according to the teacher's view. Learning is organized according to the program contents logics.	The adult learners aim their learning towards what is meaningful in their lives- for immediate use not future use. The content does not need to be organized according to the program logics.
<b>Motivation</b>	Learners are motivated to learn by external incentives such as grades, passing an examination, failing in examinations, the parents' demands and others.	The adults' motivation lies on their tendency to update their knowledge, an inner motivation, their own wish to grow, their self esteem, and fulfillment.

According to Knowles (1980) andragogy takes four hypotheses for granted and that the adults' behavior as learners differs from the children's as pedagogy's object. These four hypotheses consider that the learners: (a) change their self concept as they acquire experience and become independent and self guided; (b) acquire, through learning, more knowledge and consequently more resources for a self learning; (c) get more motivated through learning as they try to perform their social roles; (d) become more pragmatic as to the use of their knowledge, being more interested in its immediate practiced centered on problem solving.

According to Gibb (1967) adults' learning happens based on six principles: (1) learning should be centered on problems; (2) learning should be developed through the learners' experience; (3) experience should be meaningful to the student; (4) the student should feel free to analyze the experience; (5) the aims and research should be set and

carried out by the student; (6) the learners should receive a *feedback* on their progress as to the aims.

According to Cole (1981) learning in action leads to interest in the development of professional identity through exploration of skills and the discovery of vocations while carrying out practical activities (Table 2).

**Table 2. Skills and vocations**

To know / To learn	EXPLORE ABILITIES AND REVEAL VOCATIONS
Their interests	To give the learners the opportunity to know and try different work areas in order to uncover their interests and abilities.
To be	To allow the learners to immediately learn the demands of some jobs and their possibilities of fulfilling them by carrying out practical activities.
To socialize	To show the learners what is expected from them as to some kinds of activities, their daily duties, people with whom they have to socialize and the level of competition expected from them.

The learning process through the andragogy methodology assumes that the learners should pursue knowledge related to what they practice, gaining experience as they sort out real problems. They should receive, however, orientation as they progress in their learning. These new methodologies create new teaching paradigms as seen in table 3 [SEBRAE, apud Matai, 2008].

**Table 3. Comparison between the traditional view and the new teaching paradigm.**

TRADITIONAL VIEW	NEW PARADIGM
VALUES/PERCEPTIONS: a mechanistic and fragmented view of knowledge	VALUES/PERCEPTIONS: systemic view of knowledge
TEACHING: action of knowledge transmission managed by the instructor	EDUCATION: emphasizes how to learn to know, to learn to do, to learn to be and to learn to socialize.
INSTRUCTOR: focus of the teaching process.	EDUCATORS: they are the stimulators of a plural and multidimensional environment.
LEARNER: a passive element in the learning process.	LEARNERS: the reference centers of educational action, they are the agents and authors of the learning process.
CLASSROOM: the physical space for teaching.	LEARNING ENVIRONMENT: is not limited to a physical space but to the learning concept.
CONTENT: pre-determined with isolated subjects or fragmented themes.	CONTENTS: an integrated process of a meaningful construction of knowledge, interdisciplinary.
AIMS: behavioral and the teacher has control over the content being taught.	LEARNING AIMS: development of knowledge, skills and appropriate attitudes to reach an aim.
MEANS: they have teaching purposes.	MEANS: they develop sophisticated forms of multidimensional and sensorial communication, which help students learn.
RESULTS: the reach of aims can be scored.	RESULTS: evidence of ability reach in learning to know, learning to do, learning to be and to socialize.

The aim of teaching is to develop personal abilities and not only the curriculum concepts. The term competence is defined by Perrenoud (1999) *as the ability to act efficiently in a certain situation based on knowledge but not limited to it*. In this context scientific knowledge is used to build abilities and is not restricted to reflection but to development of abilities built through practical action.

Learning through practical action can be described as a process through which learners think their experience over causing *insights* or a new learning. It can be defined as

a process beginning with experience followed by reflection, discussion, analysis and evaluation of experience. Seldom, though, we learn from experience unless we evaluate it, draw our own meaning from it in terms of our own aims, purposes, ambitions and expectations. From these processes *insights* are generated as well as discoveries and understanding. The parts take their places and experience gains a meaning and form and adds to other experiences. The process is judged, synthesized and integrated to the learners' construction system. The learners impose it to the world through which they see, perceive, categorize, evaluate and search experience.

Educators such as Dewey, Lewin and Piaget, consider learning a tension and conflict process that happens through interaction between learners and their environment involving concrete experiences, observation and reflection that generate a permanent review of learned concepts. Learning is a process not a state.

The idea of learning cycle was defined by several researchers but the origin of the cycle is frequently ascribed to John Dewey (2000). The most important concept in his study on learning is the notion of experience. The author defines learning as a continuous reorganization and reconstruction of experience that happens all the time and in all situations in which people act and interact, reflect and think. According to Dewey, learning comes from a situation in which the learners are confused or in doubt or facing a problem that makes them stop and think generating a flow: situation-problem-questioning-reflection-new situation.

*If there is no interest, there will not be any learning. Much of what is taught to the individual may be forgotten. Not by stupidity, but by intelligence. The body cannot carry the weight of a dead knowledge that cannot be associated with life.*

The exercise in the activities of the profession allows exploring skills and discovering vocations within the political aspects of organizational life, because at work in any area of knowledge, it is not only the use of logic and reasoning, but also involves issues of interpersonal relationships. The ticket in life induces the individual to reflect on the concept work that he has his own connection (Intrapersonal intelligence). Its evolution begins when skills and values are tested in the midst of the tribulations of life practice. When the individual identifies himself with the activities of the profession, it is induced to empowerment, moving from passive to active form of the search for knowledge.

## **2. Cooperative Education**

According to CAFCE<sup>1</sup> – Canadian Association for Cooperative Education, Cooperative Education is a teaching methodology, which develops systemic learning through lessons and learning based on work. This model integrates businesses and school in the training of skilled professionals able to face the dynamism of the work market that demands a quick adjustment to function and updated knowledge kept up with technological innovations. The program consists of alternating periods of experience in appropriated fields of business, industries, government organs, social services organs and companies complying with the following criteria:

- Each training program is developed and/or approved by the cooperative educational institution according to their pedagogical project.
- The cooperative course learner is engaged in the productive work instead of being a mere observer.

- The cooperative course learners are paid for their work done.
- The cooperative course learners' progress at work is supervised by the cooperative teaching institution.
- The trainees' performance at work is supervised and evaluated by the company that accepts the cooperative course learners.
- The work experience period in companies should be at least 50% of the time spent at academic activities at school.

## 2.1 Cooperative Four-month Structure

Cooperative education is an education model that promotes learning through lessons based on the work. This model allows an effective integration of the companies and the higher education institutions in the formation of professionals qualified to face the dynamism of the work market, which demands fast adequacy of functions and up-to-date knowledge concerning the technological innovations.

The program consists of alternating quarterly periods of lessons with periods of professional activities in the form of curricular periods of training (Work Terms, internships). This methodology of education foresees that at least one third of a course is to be developed in programs of professional practice. The model presented considers the reorganization of the school calendar, into quarterly periods instead of the usual semesters in order to optimize the resources of the institutions and to add complementary benefits to the formation of the students. Table 4 presents a comparison between a traditional semester education models against a quarterly Cooperative model for a five-year lasting course (an engineering course for instance).

**Table 4. Semester and four-month period structure patterns [MATAI, 2007].**

Semester – Traditional												
Year	J	F	M	A	M	J	J	A	S	O	N	D
1°			Class1					Class2				
2°			Class3					Class4				
3°			Class5					Class6				
4°			Class7					Class8				
5°			Training					Class9				
Rooms			4					5				
Vacancies			1					-				

Four month period – Cooperative												
Year	J	F	M	A	M	J	J	A	S	O	N	D
1°		Class1				Class2				Training1		
2°		Class3				Training2				Class4		
3°		Training3				Class5				Training4		
4°		Class6				Training5				Class7		
5°		Training6				Class8				Class9		
Rooms		3				3				3		
Vacancies		2				2				2		

In the semester structure made up of 9 class modules at school and a full time training period 5 classrooms are needed all over the year and a set of vacancies for the training. In the four-month period structure three classrooms and two sets of vacancies are needed for the training. In this example one sees a 40% reduction (forty percent) of the number of classrooms that, besides enhancing the physical space, equipment and other resources it improves the teacher per number of learner's ratio. It is an efficient answer to meet the demand for well-trained and efficient professionals to meet the aims, vocations and abilities of each college student. The full time training activities enable the student to perform anywhere in the country and overseas pursuing the best programs for professional training through curricular trainings as a teaching complement.

The Cooperative teaching methodology includes follow-up through seminars and visits of the guiding teacher to the learners' workplace. For bigger structures, a group of training coordinators visits the students in the companies and guides them in the career development. At the same time these training coordinators make prospect ions for the opening of new training vacancies, they make and forward the students' and companies' evaluation to the school, thus generating information which will enable them to plan corrective actions in the program content of the courses preparing the majoring students for a constantly changing work market.

Annual events of co fraternization between school and the companies' directors are programmed to divulge the competences offered by the teaching institution with exchange of information and consolidation for other partnerships as well. This kind of Cooperative Teaching develops university-business interaction and motivates the students to a strong upbringing, cleanliness in the career conduction; it emphasizes employability, vocational maturity and gives the employers flexibility in the work force, recruiting and keeping trained workers.

## **2.2 Effectiveness**

The accomplishment of 6 modules of period of training of 4 months, concomitantly to the graduation, adds a professional 2 years (24 months) experience to the graduation diploma, providing actual opportunities for good jobs and an efficient fitting to the reality of the work market. The interaction between the education institution and the work market makes possible for the students to catch statistical information on the expectations of that market. It makes possible for the education institutions to take corrective actions in the program contents of the courses, and to adjust the profile of the graduated students for the constantly changing work market.

The quarterly Cooperative model represents an interesting solution for the increase of the number of admittances in the university courses. It is an efficient means to attend to the demand for fully qualified and efficient professionals.

The activities developed in the periods of training (Work Terms, internships) with exclusive devotion make possible for the students to choose to go abroad in search for the best programs of professional qualification, meaning then a complementation on their education.

## **2.3 The professor's charge**

For the models considered on Table 1, the curricular contents of both models (semester and quarterly) are equal and consequently, they require the same number of professors. When a third period is introduced, it occupies a period pertaining to school vacations, with a new distribution in the school calendar. The number of days of activities per year results to be equal to 210, as indicated in the sequence:

- 1 school year = 3 quarterly periods
  - 1 quarterly period = 4 months x 30 = 120 days or  $120 / 7 = 17$  weeks
- 1 quarterly period (or period) = 17 weeks
  - 14 weeks of activities;
  - 1 week for final exams;

2 weeks of school recess.

1 school year = 3 quarterly periods of 14 weeks =  $3 \times 14 \times 5 = 210$  days of activities/year.

**Table 5. Professor's didactic charges distribution**

The Professor's didactic charge distribution			1 <sup>st</sup> quarterly				2 <sup>nd</sup> quarterly				3 <sup>rd</sup> quarterly			
Group	Classes	Internship	J	F	M	A	M	J	J	A	S	O	N	D
1	Class 1 and Class 2	WT 1	Class 1				Class 2				WT 1			
2	Class 3 and Class 4	WT 2	Class 3				WT 2				Class 4			
3	Class 5 and Class 6	WT 4	Class 6				Class 5				WT 4			
4	Class 7 and Class 8	WT 3	WT 3				Class 8				Class 7			
5	Class 9	WT 5 and WT6	WT 6				WT 5				Class 9			

The distribution of the didactic charge could be divided into 5 groups of professors. For the example presented on table 5:

- group 1 of professors teaches lessons for Class 1 and Class 2 and supervises the students in Work Term1.
- in a similar fashion: groups 2, 3 and 4.
- group 5 of professors teaches lesson for Class 9 and supervises periods of training (Work Term) 5 and 6.
- during the modules of WT, the professors visit the students in the periods of training, interact with the supervisors of the trainee and check the conditions of the Work Terms.

At the end of the WT periods, the professors evaluate the performance of the students, considering a written report presented, their evaluation accomplished by the supervisors and the evaluations accomplished by the professors in their visit to the students

## 2.4 Academic complementation

The periods of the WT could also be carried through as an academic complementation in other areas of knowledge or in other institutions that offer periods in the quarterly structure, without compromising the student's academic devotion to the official program of the course. By being of exclusive devotion, the internships modules could be accomplished in other cities, states or in other countries. For the students, that means an increase of the work possibilities and provides an experience with other realities and cultures.

## 2.5 Course optimization with 2 unbalanced groups of students of 1 quarterly

If there is the demand for 2 groups of students, it becomes much more interesting to offer unbalanced groups of one period instead of two parallel groups. Therefore, the same academic module of classes is offered again in the next period. As the classes for the groups 1 and 2 (I and II) are programmed in different periods, that is, the classes of the group 1 (I) in the morning period and the laboratories and workshops in the afternoon period and the classes of the group 2 (II) in the opposite distribution, the use of the dependences of the institution are optimized. Tables 6 and 7 present respectively, a comparison between the schemes for a semester course and for a quarterly course.

**Table 6. Traditional semester course**

Semester - Traditional Group 1	Group 2 – diphased
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Year	J	F	M	A	M	J	J	A	S	O	N	D
1 <sup>st</sup>			Class 1				Class 2					
2 <sup>nd</sup>			Class 3				Class 4					
3 <sup>rd</sup>			Class 5				Class 6					
4 <sup>th</sup>			Class 7				Class 8					
5 <sup>th</sup>			W Term				Class 9					
<b>Class</b>			<b>4</b>				<b>5</b>					
<b>Work</b>			<b>1</b>				<b>-</b>					

Year	J	F	M	A	M	J	J	A	S	O	N	D
1 <sup>st</sup>								class 1				
2 <sup>nd</sup>			class 2				class 3					
3 <sup>rd</sup>			class 4				class 5					
4 <sup>th</sup>			class 6				class 7					
5 <sup>th</sup>			class 8				w term					
6 <sup>th</sup>			class 9									
<b>class</b>			<b>5</b>				<b>4</b>					
<b>work t</b>			<b>-</b>				<b>1</b>					

**Table 7. Quarterly period course**

Quarterly periods - Cooperative – division I												
Year	J	F	M	A	M	J	J	A	S	O	N	D
1 <sup>st</sup>	Class 1			Class 2			Class 3					
2 <sup>nd</sup>	Wterm 1			Class 4			Wterm 2					
3 <sup>rd</sup>	Class 5			Wterm 3			Class 6					
4 <sup>th</sup>	Wterm 4			Class 7			Wterm 5					
5 <sup>th</sup>	Class 8			Wterm 6			Class 9					
C	C1/C5/C8			C2/C4/C7			C3/C6/C9					
W	W1/W4			W3/W6			W2/W5					
<b>Class</b>	<b>3</b>			<b>3</b>			<b>3</b>					
<b>Work</b>	<b>2</b>			<b>2</b>			<b>2</b>					

Group division II – diphas in one period												
Year	J	F	M	A	M	J	J	A	S	O	N	D
1 <sup>st</sup>						class 1			class 2			
2 <sup>nd</sup>			class 3			wterm 1			class 4			
3 <sup>rd</sup>			wterm 2			class 5			wterm 3			
4 <sup>th</sup>			class 6			wterm 4			class 7			
5 <sup>th</sup>			wterm 5			class 8			wterm 6			
6 <sup>th</sup>			class 9									
C	c3/c6/c9			c1/c5/c8			c2/c4/c7					
w	w2/w5			w1/w4			w3/w6					
<b>Class</b>	<b>3</b>			<b>3</b>			<b>3</b>					
<b>Work</b>	<b>2</b>			<b>2</b>			<b>2</b>					

The observation of Table 6 shows that the two groups of the semester model need 9 (4+5) classrooms in the first semester and also the same number of 9 (5+4) classrooms in the second semester, and a set of vacancies for the WT (internship) programs. The students of group 2 in the second semester will fill the set of vacancies filled by the students of group 1 in the first semester. Those students substitute the students of group 1, as they return to the education institution. Table 7 points that the two groups of the quarterly model need 6 (3+3) classrooms and 4 (2+2) sets of WT (internship programs) vacancies. The observation of Table 6 shows that the two groups of the semester model need 9 (4+5) classrooms in the first semester and also the same number of 9 (5+4) classrooms in the second semester, and a set of vacancies for the WT (internship) programs. The students of group 2 in the second semester will fill the set of vacancies filled by the students of group 1 in the first semester. Those students substitute the students of group 1, as they return to the education institution. Table 7 points that the two groups of the quarterly model need 6 (3+3) classrooms and 4 (2+2) sets of WT (internship programs) vacancies.

The comparison between the traditional semester model (table 6) and the quarterly Cooperative model (table 7) with two unbalanced groups of one period shows that the first one needs resources for 9 classrooms, against 6 classrooms for the Cooperative quarterly system. The alternation of the academic periods and the WT (internship) periods, allows the optimization of the institutions resources such as libraries, classrooms, laboratories, microcomputers, software, and other items. Table 8 presents the use of the resources employed by the students of the semester courses and during the quarterly courses.

## 2.6 The optimization resources

The university education requires the use of new technologies such as microcomputers, educative software, laboratory equipments, multimedia devices, and videoconference

rooms. The optimization does not reduce the number of classrooms, laboratories and workshops, but it extends to the technological resources, that get obsolete. The resources use should be intensive to compensate the monetary investment. As the groups of students are unbalanced, twice as much the students will use the same equipments.

**Table 8. Courses with two groups diphase of one period**

Resources used in the courses (5 year Engineering courses)	Semester	Quarterly
Classrooms	9	6
Library, microcomputer rooms, laboratories, project rooms, workshops and other dependences.	For 9 groups	For 6 groups
Books, microcomputers, software, laboratory didactic instruments and other equipments.	For 9 groups	For 6 groups
School recess in the year	4 months	6 weeks
School occupation during the school year	34 weeks	45 weeks
Curricular period of training	4 months	24 months
Set of WT (internship) vacancies	1	4

### 2.7 Distribution of the Professors didactic charge

According to the contents presented on Table 9, it is possible to distribute the professors' didactic charge in the quarterly model that comprises two groups, into 3 groups of professors. A group of professors "X" teaches for instance, in the period between May and August, the set of disciplines relative to the modules of class "C2, C4 and C7" and the disciplines in the third quarter (September to December), for the modules "c2, c4 and c7" of group II. In the following quarter (January to April) the professors supervise the students of the internship modules "W1, w2, W4 and w5". The groups "Y" and "Z" are organized in an analogous way.

### 2.8 Evaluation of the internship periods

The evaluation of the internship periods comprises the evaluation accomplished by the supervisor at the company and by a professor and a report concerning the period of training. Forms that evaluate the abilities and attitudes of the students in the activities during the internship periods of training are guides to bring feedback to the educational institution. The visits accomplished by the professors in the companies contribute for the establishment of a solid integration between the university and the corporation.

**Table 9. Professors' charge periods**

Distribution of the didactic charge												
	J	F	M	A	M	J	J	A	S	O	N	D
X	W1/w2/W4/w5				C2/C4/C7				c2/c4/c7			
Y	c3/c6/c9				w1/W3/w4/W6				C3/C6/C9			
Z	C1/C5/C8				c1/c5/c8				W2/w3/W5/w6			

**Table 10. Levels of the internship periods**

Distribution by period of internship level												
	J	F	M	A	M	J	J	A	S	O	N	D
A	W1				w1				W2			
B	w2				W3				w3			
C	W4				w4				W5			
D	w5				W6				w6			

### 2.9 Classification of the internship periods

The basic requirement in the internship periods is that the students deeply experience the work environment. Many times, the whole participation of the students is dependent on the level of acquired knowledge. It requires greater or minor supervision and orientation. That

is, in the same company the internship vacancies can be related to simple tasks and others could demand more maturity and a higher level of knowledge. Although it is reasonable that students of the first years can occupy more complex vacancies, a student of the last years does not have to occupy vacancies related to simple tasks. The availability of vacancies by school year demands small corrections in the internship plans and some adequacy to the level of the student. If the vacancies are divided into groups by school year, ranks are created and a criterion of planning and control must be established in order to select the students. Table 10 presents an organization of the internship periods of training of the two groups of students, gathered in 4 groups. The internships could be accomplished in different companies, in different departments of the same company, in companies in the productive chain (supplying company, producing company and company customer), in social projects, research institutes and other universities. These vacancies are reclassified for students within different levels of knowledge and that demand different levels of supervision.

### 3. Competences

The development of competences involves a change in structure and meaning of work practices. In this sense a fundamental aspect refers to use of knowledge in work situations (know how to act). Knowledge is built and, at the same time incorporated to attitudes and it appears in actions and work practices.

An analysis of competences with the use of *Veca* method [MATAI, 2007] among students of cooperative courses at EPUSP evidenced that the activities of curricular trainings develop personal competence potentials demanded by the work market (table 11). In another study using the *Siewert* method on the competences which would define “what makes” a good teacher from the learners’ viewpoint, it was concluded that the students seem to consider the didactical, pedagogical or technical qualities fundamental but they attribute a major importance to such qualities as leadership, participation, interest in the students and knowledge of the subject being taught, which indicates that it is not only the students who should develop competences but the teachers should also master their job [MATAI,2003].

**Table 11. % of students with the installed competence.**

% students with the installed competence	Traditional		Cooperative
	%	Difference	%
Planning	94	(-4)	90
Organization	73	2	75
Control	44	16	60
Leadership	57	13	70
Communication	84	16	100
<b>Decision</b>	37	23	60
<b>Execution time</b>	74	21	95
Operational intensity	90	10	100
<b>Relationship with the authority</b>	89	(-34)	55
Flexibility and creativity	19	1	20
Attention e Priority	87	(-12)	75
Detail e Delegation	26	14	40
Administration of conflicts	74	1	75
Emotional control	86	14	100
Disposition to change	91	(-6)	85
Affectivity	96	4	100

Realization	94	6	<b>100</b>
Self image	66	14	<b>80</b>
Sociability	99	1	<b>100</b>
Physical mobility	82	8	<b>90</b>

### 3.1 Academic Performance

According to Perrenoud (1999) a simple explanation, given for students who had taken little advantage of their courses, is that they were not really interested in them. If they were, they would have achieved better results. If this type of reasoning is valid, the interests could be highly and positively correlated with measures of performance in courses and training programs. Possessing the necessary minimum of aptitude for the course, the interest could be followed. The efficiency of the individuals at school depends on their capacity, a previous preparation and the desire to be successful. The individual's interests play a certain role in the course chosen. According to Hersey (1974) the students with high accomplishment necessity, generally obtain better grades than those equally intelligent students, but with lesser necessities of accomplishment. When they possess the motivation, they tend to accomplish a better performance when they associate the academic formation with the practical activities in the profession (curricular periods of training, internship programs), because they constantly think about better ways of accomplishing things.

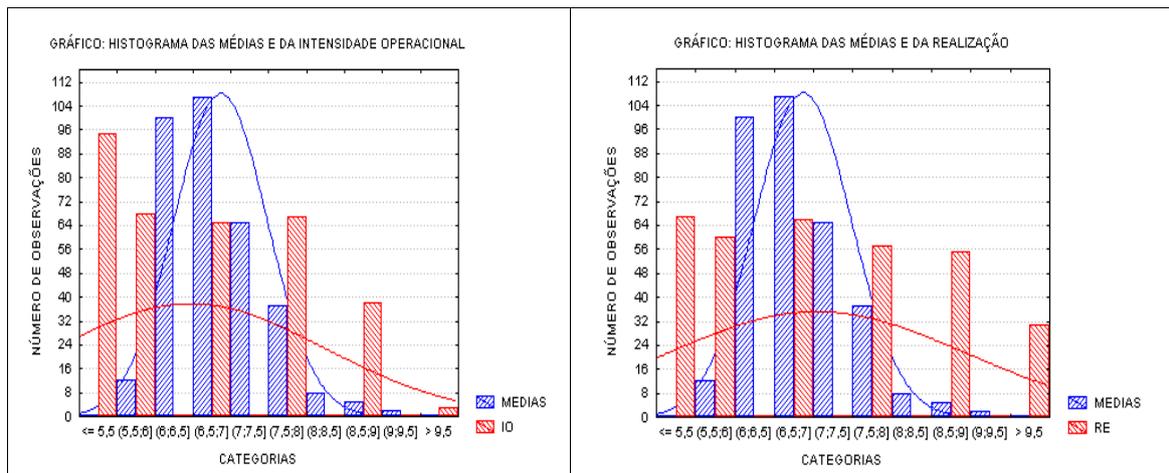
### 3.2 Operational intensity and accomplishment

The data of the academic performance, measured through the global weighed mean of the academic disciplines for the graduated of 2002, in comparison with its results attained by the Poli MapCom, was placed to verify which abilities of the mapping were more correlated with themselves. In the analysis of the histograms, two abilities had presented a sufficiently interesting parallel with the academic averages attained by the students: operational intensity and accomplishment. The histograms presented in Table 12 show the proximity between academic averages and the scores for ability. Shaping for a normal behavior, the average value for the academic average was of 6,86 with a shunting line standard of 0,62.

Results on table 12 showed that the abilities where the students of the Cooperative courses showed the best performance (100%) had been Operational Intensity and Accomplishment that could be associated with the persistence and to the interest for activities such as group Communication, Emotional Control, Affectivity and Sociability.

**Table 12. Operational intensity and accomplishment**

COMPETENCE	average	standard deviation	COMPETENCE	average	standard deviation
Operational Intensity	6,46	1,77	Accomplishment	7,02	1,90



In percentage figures, the group of graduated students of 2002 of the Cooperative presented superior academic performance when compared with the students of the conventional engineering courses. About 19% among the first 100 classified students were from the cooperative courses against 12% from the conventional courses. Five of the cooperative students were classified among the first 16 students. The individual academic performance was directly proportional to the performance in the periods of training (internships). Students who had had satisfaction in the activities (and not just for a reward) of the periods of training had also achieved excellent academic performances.

It is important to point out that the indices of evasion in the cooperative courses practically do not exist. Moreover, it is important to observe that the great majority of the cooperative students graduate in a period of five years. The internship periods have been highly motivating the students for their role as engineers. In the conventional courses, the internship programs carried together with the academic periods can create problems concerning the devotion of the student in the studies. The cooperative courses show that the alternation of academic periods and internship periods bring many benefits for the students.

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#### 4. History

The first known register of Cooperative Education is in the *British Sandwich Program* that was developed at *Sunderland Technical College*<sup>2</sup> in 1903, in the course of Naval Engineering and Architecture. The course consisted of an integration of the academic teaching with training at the naval industry. The course demanded a considerable long training period in industries: about 18 months for 4 year graduation programs and 12 months for 3 year graduation programs.

##### 4.1 Co-op Education in the United States

In the United States, Cooperative Education began in 1906 at Cincinnati University<sup>3</sup> in the Engineering courses. The visionary Professor Herman Schneider thought as follows: *many elements in most jobs cannot be successfully taught in classroom but require practical*

*experience for the appropriate command. Most of the students needed or wished to work during studies but the available kind of work at the time had poor characteristics and had no relationship with the study program.*

At that time he signed conventions with 13 local employers to admit 27 students in a program, which alternated work periods. The students acquire professional skills, through trainings during Cooperative Teaching, and when they major, they become more competitive.

#### **4.2 Co-op in Canada.**

Cooperative education was introduced in Canada in 1957, when Waterloo University<sup>4</sup> began its first “Co-op” program in engineering courses. It grew slowly in the beginning but after 1970 it rapidly expanded to other universities in the country. In 1989, an impressive number of students registered in “Co-op” programs in more than 115 universities in Canada.

#### **4.3 Co-op Education in Brazil.**

Escola Politécnica – University of São Paulo (EPUSP)<sup>5</sup> represented by their professors Osvaldo Fadigas Fontes Torres and Décio Leal de Zagottis implemented a Cooperative Course in 1989 following the model of the Waterloo University in Canada. Production, Chemical and Computer Sciences Engineering Courses were offered as a choice for the exact sciences entrance examination. In the 1999 curricular reform, the Cooperative courses were adapted to the EPUSP new structures: they were offered in the four month period structure as a choice in the major areas of Chemical and Electrical Engineering only after the second year at school.

The Universidade Federal de Santa Catarina<sup>6</sup> started their Cooperative Education project in 2001 by offering the course of Materials Engineering in the four months period structure during the whole course.

### **5. View Of The Future**

Conventional teaching has a century old structure of which the philosophy is based on reaching aims. This teaching model is based on the principle that each student, in order to reach an aim, should acquire knowledge or learn a skill. It is presumed that there is the possibility of specifying all the necessary material so that the students can associate the effort demanded from them to a clear statement. In this context, the process induces the students to expect and the teacher to strongly stress what should be learned. This teaching model implies mainly the fact that it is appropriate to be driven to answers since this is how the students are evaluated in order to assess if they have reached the learning aim. To give the right answer as a result of manipulation of instruments, data or ideas according to what was taught to them is the best indicator of a successful learning. In this educational system, conditioning leads to ability to perform in the present, which in a short time will be or has already, become past.

The training of professionals for a technically constantly changing globalized market requires a teaching methodology that promotes a symbiosis with this process of changes and, above all allows the students to try their skills, aims and values efficiently for the development of their professional identity. This will take longer if their experience is poor or developed later in their professional lives. Talent without motivation gradually

atrophied. Inversely, new challenges can bring to surface latent talents, which were not revealed. The new methodology should adjust people to different kinds of life and choices of work linked to their natural abilities and existing in their culture: an adjustment which will become a source of self fulfillment and of contribution for social welfare.

A modern educational system aims mainly at giving the students the responsibility to pursue their own education and it will be developed in such a way that these students will overcome the idea that education only happens at school. It should also consider that it is no longer possible to make the students learn in the present everything they are supposed to learn neither is it possible to believe that one can learn everything. This ideal is no longer possible. Much of what has to be learned to the end of the course has not been discovered or invented and in a few years part of what the students have learned will become obsolete. In this scenario training becomes a process and no longer a state.

The Cooperative Education is a comprehensive educational model that provides both, generalist and specialist training and above all, it provides in an individualized way, the aptitudes and vocations of each engineering student. It provides training to meet the demands of the labor market without losing the spirit of creating for the future.

The expansion of vacancies through the cooperative model of teaching will propose a dynamic, effective and andragogy teaching methodology and a learning model through efficient, modern and simultaneous methods and not an artificial and protected environment but one intertwined with work and life.

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<sup>1</sup>[www.cafce.ca](http://www.cafce.ca)

<sup>2</sup>[www.sunderland.ac.uk/university/history/](http://www.sunderland.ac.uk/university/history/)

<sup>3</sup>[www.eng.uc.edu/welcome/history/](http://www.eng.uc.edu/welcome/history/)

<sup>4</sup>[www.uwaterloo.ca](http://www.uwaterloo.ca)

<sup>5</sup>[www.poli.usp.br](http://www.poli.usp.br)

<sup>6</sup>[www.materiais.ufsc.br](http://www.materiais.ufsc.br)