

Cooperative Education: the knowledge of the competences

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Abstract - Cooperative Education is an education model in which academic periods at the university are alternated with internship programs in corporations, research institutes and social projects. The combination of academic education and professional experiences through internship programs allows the students to use their natural and acquired skills in the actual situations. Psychological tests, or else, the inventories of interests are originated from the experimental Psychology that had a strong growth in the forties in Europe, United States and Russia. Usually the inventories are organized in the form of forced answers. The evaluation instrument tries to provide a scientific basis through the factorial analysis with the aim of determining which variables would be related to a significant behavior. This paper presents the results of a study accomplished by a specialized company through an agreement with the Association of the Polytechnic Engineers applied to a group of graduated students of the Cooperative engineering courses of Escola Politécnica with the objective of pointing their natural competences.

Index Terms - Competences, Cooperative Education, Engineering Education.

INTRODUCTION

The constantly changing current work market demands the professionals to continuously update their knowledge and also to employ it to develop themselves in any similar area to their formation, by imposing a flexible behavior concerning education and learning.

An important matter in engineering education is the Engineer degree itself. Already, the adjective entrepreneur, constructor, inventor, manager, consultant, professor, governor, minister, will be conquered within the several work options towards the natural competences existing in every culture [1]. Within this context, new professional qualifications are valued: to learn how to learn, promptitude in the resolution of the problems, relational maturity, social and ambient responsibility, emotional intelligence and strategy of the ability directed to the services of the companies. The new paradigms lead the individual to assume personal responsibilities in unexpected situations, to take decisions when under pressure, to assume management positions, to have an enterprising spirit that implies in

developing attitudes that mobilize intelligence and to employ intuition and interpersonal relationships.

The goal of education not only passes through the development of personal abilities but is related to the curricular concepts. Education focused on ability demands and sends to a narrow interaction between the institutions of education and the productive sector, to adjust, to bring up to date and to evaluate new labor profiles, in order to keep up with the transformations in the work world and also with the current technological society. Competence is the set of knowledge, abilities and attitudes that, applied to practical situations, can take to qualitative and quantitative results for the organizations and for individuals [2]. The ability concept constitutes a valuable tool for the individual formation. The development of an education methodology that assumes a curriculum based on ability, impels centralization in the student, that is, with focus in the learning process. The objective is not simply to teach but to assure that the student effectively learns. That implies in a change in the role of the schools, professors and students. It is expected the existence of an effective participation of the students in their own project of learning, concerning auto-evaluation, auto-development and self-knowledge. The students must know which are their weak and strong points and natural abilities in order to choose a path.

This paper presents the results of a study accomplished by a specialized company through an agreement with the Association of the Polytechnic Engineers applied to a group of graduated students of the Cooperative engineering courses of Escola Politécnica with the objective of pointing their natural competences.

THE COOPERATIVE COURSES AT ESCOLA POLITÉCNICA

Cooperative education is an education model in which academic periods spent at school are alternated with internship programs spent in companies, corporations and research institutes. It is a model that allows the combination of academic formation with experience acquired in the work market, through curricular periods of training. In the Cooperative Courses at Escola Politécnica, the first year is run on a semester basis and it is common to all the engineering students. The second year, also run in a semester basis is common to the students of a Major Area (Civil, Electric, Mechanics and Chemistry). From the third to the

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fifth year the course is run on a quarterly basis where the academic periods (A 1 to A 5) are alternated with the internship periods (I 1 to I 4) as presented on Figure 1.

FIGURE 1
COOPERATIVE COURSES (3RD TO 5TH YEAR)

A 1	I 1	A 2
I 2	A3	I 3
A 4	I 4	A 5

In such a way, the students have the opportunity to carry through 4 modules of 4 months each of training with exclusive devotion, exploring aptitudes and discovering vocations as they exert diverse functions. That allows the students a valuable experience and the opportunity to practice and check their acquired academic knowledge.

THE EVALUATION OF THE COMPETENCES OF THE STUDENTS

According to [3], some difficulties exist when people are submitted to psychological tests, such as in the shunting line in the reply, when they show a tendency that predispose them to answer in order to distort the results; or in the lie, when deliberately they try to distort the answers; or in the assent, that some people have to agree with and to answer positively to almost all the formulated questions; or negativist in the opposing situation; or in the social acceptance, when they answer in a socially acceptable way, or in the way they consider as being correct.

The tests possess a great value in occupational psychology, in two processes: selection and orientation. Another important point refers to the validation of the methodology of the test that depends on its relations with a significant behavior and how much to the security that the consistency or the stability of the test denotes. Therefore, the interpretation of the results (interview) requires qualified people with knowledge for this end, capable to filter the attempts to distort the results, as well as the trend for typical answers, of which a person cannot be conscientious. Since 2002 the AEP - Association of the Polytechnic Engineers at the University of São Paulo has been providing an orientation to the recently graduated students and to supply an indicative to Escola Politécnica on the profile of the egresses. In such a way, AEP initiated a project for career orientation through a partnership with Alba Consultoria, a consultant company.

The evaluation instrument VECA®

The Poli MapCom Project – The Mapping of the Abilities coordinated by AEP had the objective among others, to catch financial support from local companies. The construction of the strategic model of abilities and its measurement demanded an expertise in psychology and correlation with organizational functions. Alba Consultoria, proprietor of the instrument VECA® (a sufficiently recognized methodology in the enterprise way) was chosen, because it presents a proposal of strategic partnership to act in the educational ambience.

According to [6], the development of VECA®, Instrument of evaluation for Abilities, was initiated in 1968, based on research and in experimentation, adding to its trajectory an experience of more than 400 companies and 110,000 executives of the most varied fields. It is presented in the form of a questionnaire of forced choice. Presenting a set of 100 pairs of questions, the questionnaire makes possible the mapping of the 20 basic abilities required for management [2], [4], [6]:

INDIVIDUAL: Intentionality/Subjectivity: To want - To direct - To decide: • Vision (Subject X Project), Planning, Affectivity, Decision, Disposal for change, Priority, Self Image, Control, Delegation and Flexibility.

PROJECT: Extension /Rational: Potential - Accomplishment - Development • Relationship (Subject X Object): relation with Authority, Emotional Control, Administration of conflicts, Communication and Sociability.

OBJECT: Attention/Objectivity: To know - To analyze - To discern • Results (Object X Project): Execution time, Organization, Mobility, Accomplishment, Operational Intensity and Priority.

Through the factorial analysis, together with a strong work of gauging and research, VECA® establishes multi-factorial correlations, giving congruence and predictive value to the results.

The answers are punctuated and compared with a statistics of the work market. If the punctuation occurs inside of a significant band, it is understood that the individual possesses the installed ability within the expected standards. If it falls above of this band, it is considered as excess. If it lies below, it is considered as a lack. For example, in the case of the control, the individuals cannot be aware of the tasks under their command. It is considered as being a lack in that ability. If it reaches a scare above of that band, the extreme control can compromise the environment and also the relationship with the subordinates that carry through the tasks that its supervises. Figure 1 presents the results of Poli MapCom [2] indicating the strong points of the graduate of 2002. For instance: 72% of the students presented the competence Planning ability (PL) within the punctuation band inside the expected standard. The basic or universal abilities measured by the instrument VECA®, are: planning, organization, control, leadership, communication, decision, execution time, operational intensity, relation with the authority, flexibility/creativity, attention/priority, detail/delegation, administration of conflicts, emotional control, disposal for change, affectivity, accomplishment, self image, sociability and mobility. Figure 2 presents the results in which the graduated of 2002 had presented the highest percentile of installed abilities. The results presented on Table 1 coincide with the previous studies, run by Brighenti (Table 2). The profile of the graduated students of 1997 was compared, and also against the data attained by the researcher [5] (Table 3). In this case, data concerns the profiles of the students of the two models of education in the University of British Columbia in Canada [2].

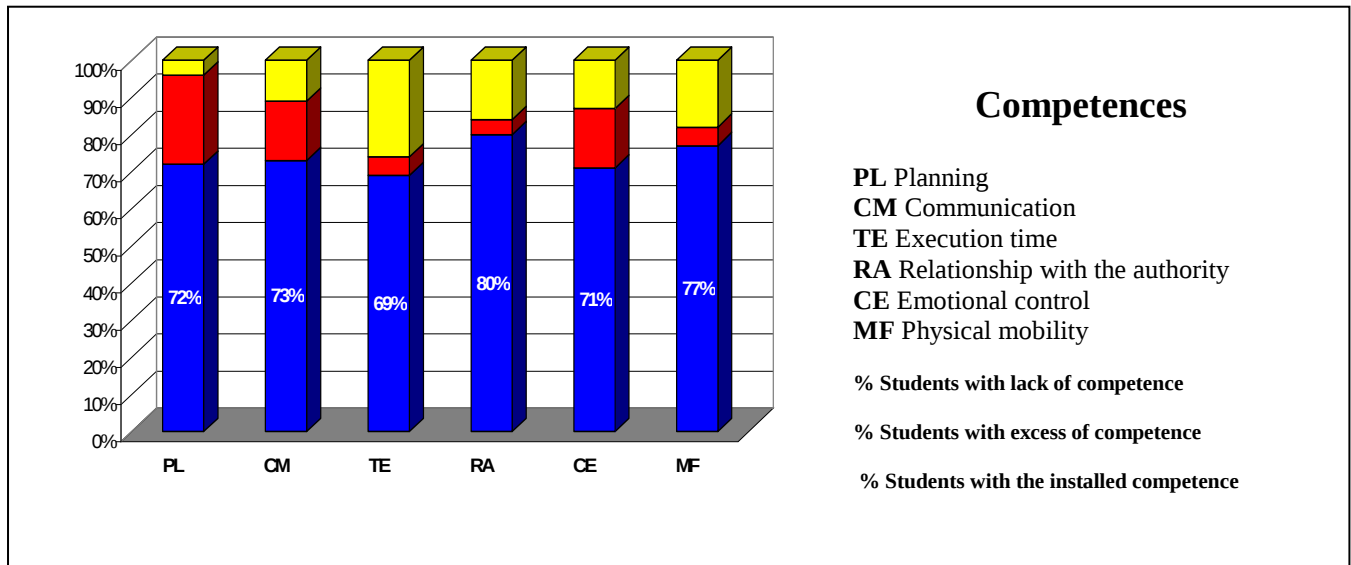


FIGURE 2
HISTOGRAM OF THE MEAN PROFILE OF THE STUDENTS GRADUATED IN 2002

Although with different questions, the results presented by [2] also indicate an accentuated advantage for one of the courses and the same moderate evaluation for creativity, a result normally evidenced in institutions with rigid standards. The study presented on Table 3 takes gender into consideration. The verbal ability seems to indicate that the females in the cooperative courses of the University of British Columbia present a better ability in

argumentation, one of the qualities that compose the ability in interpersonal relationship, always requested for the work market, in the same way that it is differentiated in finding potential employers. It is interesting to observe that the questions concerning reasoning, individual work and deepening of the knowledge, indicate a better punctuation for the students of the traditional courses, confirming their excellent performance in individual work.

TABLE 1
COMPARISON OF THE % OF STUDENTS IN THE TRADITIONAL AND COOPERATIVE ENGINEERING COURSES WITH THE INSTALLED COMPETENCE - POLI MAPCOM[2]

% students with the installed competence	Traditional	Difference	Cooperative
	%		%
Planning	94	(-4)	90
Organization	73	2	75
Control	44	16	60
Leadership	57	13	70
Communication	84	16	100
Decision	37	23	60
Execution time	74	21	95
Operational intensity	90	10	100
Relationship with the authority	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
Afectivity	96	4	100
Realization	94	6	100
Self image	66	14	80
Sociability	99	1	100
Physical mobility	82	8	90

TABLE 2
THE PROFILE OF THE GRADUATE STUDENTS OF 1997 [2]

DEVELOPMENT OF ABILITIES, ATTITUDES AND VALUES		
(Partial table)	TRADITIONAL	COOPERATIVE
32.engineering reasoning	very high	very high
33.capacity to work/take decisions by themselves	sufficient	very high
34.creativity	low	sufficient
35.critical sense	low	sufficient
36.capacity to apply theory into practical situations	reasonable	sufficient
37. personal and professional maturity	reasonable	very high
38.personal and professional discipline	reasonable	very high
39.initiative, leadership	(not observed)	very high
40.entrepreneurship	(not observed)	very high
41.communication capacity	(not observed)	very high
42.interpersonal relationship	individualist	cooperative, team work
43.human relationship	poor/reasonable	excellent
44.values	(not observed)	financial=professional=personal
45.commitment with the society	(not observed)	high

ACADEMIC PERFORMANCE

According to [3] 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 [4] 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 accomplishment 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.

TABLE 3
DATA ATTAINED BY [5]

OPPORTUNITIES, KNOWLEDGE AND ABILITIES	Cooperative Male %	Cooperative Female %	Traditional Male %	Traditional Female %
Self reasoning skills	84,3	88,9	91,0	92,3
Abilities to take decisions	82,1	88,9	76,6	80,7
Writing skills	62,0	75,3	64,8	66,9
Oral skills	56,1	70,1	42,7	49,3
Group work abilities	85,3	88,1	65,5	71,5
Leadership skills	58,4	54,6	38,0	49,2
Development of specific tasks	68,9	67,3	54,5	54,6
Individual Works	81,4	83,7	86,9	88,5
To improve the knowledge	89,3	87,3	91,7	90,8
Information about the tasks to be accomplished	71,8	68,5	46,2	41,6
To find potential employers	76,6	64,9	21,4	23,1
Opportunities to get good salaries	93,2	85,7	70,4	76,1
Information about the work market	62,8	59,3	33,1	29,2

TABLE 4
OPERATIONAL INTENSITY AND ACCOMPLISHMENT: MEAN AND STANDARD DEVIATION

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

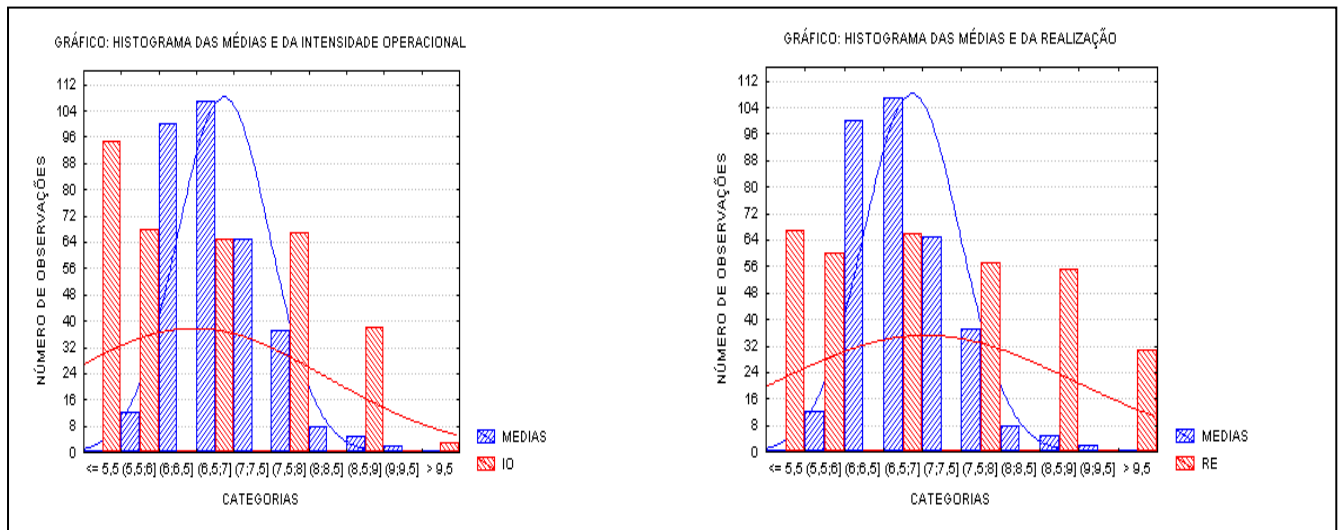


FIGURE 3
HISTOGRAMS FOR THE ACADEMIC AVERAGE X OPERATIONAL INTENSITY AND ACCOMPLISHMENT.

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 Figure 3 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 1 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. 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 inexist.

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 alteration of academic periods and internship periods bring many benefits for the students.

CONCLUSION

In education, the professor, the researcher and the engineer repass information of science and technology to the students, who will process them into knowledge and abilities of logics, mathematical and logical reasoning. The formations of engineers requested by the current work requires the performance of effective educators, therefore the education beyond a good formation, also gains to the individual a behavior and an attitude. The new paradigms of the work market require a set of knowledge, abilities and attitudes. Concerning the scientific-academic point of view, the validation of the methodology of the applied test was not questioned; therefore the study only analyzed the differentiations presented among the diverse individual courses of Escola Politécnica. The main objective was to get an indicative through a tool employed at the work market. The great prominence of the group of the graduated of 2002 and also of 2003 and 2004, was the excellent capacity to operate in organizations employing the abilities of planning, communication, time of execution, relation with the authority, emotional control and physical mobility (as presented in figure 2). The contribution of the psychological tests is to supply previous information that precedes the process of the career orientation, i.e. it stands for an opportunity of self-knowledge so usefull for decision taking concerning the professional performance. Those tests attempts to cooperate in solving problems of a model of education focused on ability. They do not constitute a final solution and their application must be effected with ethics and precaution.

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