THE ENGINEERING AND COGNITIVE DEVELOPMENT

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Abstract- *Engineering course (civil, electric and mechanic) have the purpose in graduating technicist professionals, and they are sure this technician knowledge is all the students need to manage resources in any kind of firm they might work.*

However, before finishing the course, probation provides to the student a practical contact in his professional area, and here his a surprise. The student discovers that he doesn't know anything about people and their behavior, he doesn't know anything about his country (politics, economic, etc.) and how these subjects influence his possible job and the firm where he is a trainee and intends to manage; he doesn't know how the product is sold and how much costs one minute lost in any process of work. Is the student guilty?

Through Piaget's thoughts, he is guilty due to the constant need (necessity) of growing because he hadn't looked for more information beyond his teacher has taught in class room.

Through a technician knowledge taught during his course, he isn't guilty; he is an outcome of knowledge, ideas and dreams which flows to his teachers.

But this students needs to complement knowledge, as Mechanical Engineering Department from FEI shows us.

Where were introduced knowledge from Psychology, Law, Ecology and Social Science. Students discuss about daily subjects developing critic sense.

Some tools help in this discuss and critic sense development process just as games, simulation , group dynamics and others which are applied on Engineering courses.

Games and simulation are used to show to the students a landscape of firm reality or another situations which the student might work. Group dynamic try to make easy the understanding process of behaviors and circumstances from day-to-day of the firms.

So, we propose a work that has been tested on the Chemical Engineering Course, in the classes of Economic Theory and Administration to try to turn our next engineering in capable and coherent people in their graduation

Introduction

The change demanded in engineering courses is a discussed theme insome years, This changes have startede with transformations happened in the labor market. The recently-formed engineers can´t find now in their new world a series of demands filled knowledge acquired in their graduation. Computer science knowledge, administration, costs, personnel's control, psychology, besides creativity, leadership, initiative, negotiation capacity, general culture and other characteristics.

Those demands from the market, initially, were found in some recruitments, today it is natural to find them in any employment announcement.

The change felt in the work field is reflex of a global movement. Demands are outcome of the easiness of change of information and the competitiveness in which the companies are inserted.

Second Toffler (1997), we are outcome of a new civilization that brings new family styles, different manners of working and living. We can be called the " age of the information " or " society superindustrial ", but none of these terms defines the width of this new wave that lives the world clearly.

The world passed by two big waves: the first was the agricultural revolution; the second was the access of the civilization to the industry. They transformed the way of life of the civilizations and together with those transformations some appeared, as the non-stop learning, besides the own innovations inserted in the people's life. The engineering beginning in the first wave, when men already had the need to develop objects that protected them this objects helped them and transformed them in somebody more efficient. In the second wave, the industrial revolution pushed the knowledge and the discoveries. The teaching has developed jointly to these big waves. Being na engineer, at that time, was a sucess certain, this profissional had the sure of knowledge wizard. Even so, the transformations continued and the teaching kept the same structure, and the appearance of

the 3rd wave, new questions have appeared, new discoveries, new needs and the teaching of engineering needed to pass for a transformation.

The third wave challenges the old relationships of power. It brings along life based on diversified and renewer energy; in production methods that turn into obsolete the lines of assemblies of the factories; it takes us besides the standardization, of the sincronization and of the centralization.

The changes are real and fast, so it is necessary to contemplate changes in the form of the teaching-learning process in the engineering courses, as well as lifting new ideas to go with the evolutions that are happening.

Inefficiency of the teaching-learning process in the engineering courses

The class room, in an engineering course, it is formed by students that wait the teachers to pass their knowledge (even if this class is textctly the same as their first one), the content has take full of mathematical formulation and calculations (even if the studente don´t know where they will use), easy evaluations (even if these tests have the purpose of purshing or rewarding who has made if by heart).

The student goes to the class without understanding the relationships that exists among disciplines. The knowledge acquired in the studied disciplines are stored (in the student's brain) as a file full of separated folders and then the knowledge will not be applied.. This back of multiple discipline in the course causes a high waiver in some courses and a lack of practical in the professional future.

Research activities and extension are not stimulated due to the problem of the minimum content that needs to be passed. With that, the students are limited to study only what is taught in classroom or what they can copy from somebody. The use of didactic books is for those who want to earn a more little of time and to try to learn addition what was passed for the teacher. The publication of good papers isn´t part of the daily graduation; complemental readings won't be collected, then they are not researched; papers in another language are more difficult to deal , so teachers can´t indicate them – so think the students.

The description done above is the reality of most Brazilian universities. In spite of the constant changes lived in the world, the growwing use of the computer, the change of information through satellite, the use of internet for search of current information in a fast way, the creation of softwares that help in the creation of products, factory, planning of factories, control and many others things. This way, the teaching continues the same as in the beginning of the century. We can use many justifications for that fact, but our objective is to show the problems and try to find practical solutions for them.

Engineering students are guided to be technicals, so work in group, social vision of the course, concern with the economic situation of the country, general culture, psychology or other kind of knowledge that doesn´t belong to their technological area are not part of their daily concerns. Disciplines as: economy, administration, legislation, ecology and human resources are studied for them just to complement theirs credits. The teacher should not demand a lot effort from the students. This concept is formed during the course due to the back of relation among the disciplines and their purpose in the engineer's global formation.

It is very preoccupying the distance among the market needs the new engineering professionals and what is offered for the universities. There are problems that need to be solved in the global context of the education, but there are creative solutions that can be used to minimize those problems. It is necessary that the positive experiences are shaim to other teachers and students can increase their experience, new ideas and try to change their context. The observations done here and the proposals that will be done are fruit of a work accomplished in the discipline of Economy of the course of Chemical Engineering and Analysis of Systems of a University inside the State of São Paulo and of the change of experience in the masters degree course where new teaching techniques were discussed, change needed in the methodology and presented content.

Experience introduced in the Discipline of Economy

The economy discipline was included in the curriculum of the course of Chemical Engineering and Analysis of Systems whith the objective of giving to the student an idea of the economic relationships that involves the universe where the companies accomplish their transformations. The content of the discipline is composed of topics about microeconomics and a small macroeconomics notion. The fundamental idea is to offer to the students a vision of the economic world and its influence in the attitudes taken in the companies. As: release of new products, cost reduction, increase or decrease of production amount, maintenance or not of stocks, application in investment or in the finance market, to rent or to sell equipments.

The discipline demands from the student reads a big amount of texts and familiarize with parallel subjects, as: which is the influence of the increase of the interest rates in the production? Why does the government control the imports and exports? What causes the unemployment and the inflation? How should an engineer act inside of a company?

In the beginning of the discipline a well-known technique was used as group dynamics. The group dynamics is known as the development and research of experiences on the psychology of the groups of tasks and the psychology of the formation groups. It refers to a

group of work technicians in group (Minicucci,1997). It can be used for personnel's selection, observation of work groups, conflict analysis. The objective of the use of the group dynamics, in this case, was to identity of the expectations of the group about the discipline and break ice in the relationships among the student/student and student/teacher.

The great surprise during the dynamics was to discovery that the discipline wasn't welcome. The students were surprised due to the new experience (dynamics) and they were shown disposed to participate in new experiences, but not encouraged in learning about economy. It made part of the activity the rising of suggestions to transforminto an interesting and attractive discipline. In the given suggestions were: seminars, others dynamics, interative class and the use of games to facilitate the understanding of the topics of the discipline.

One of the difficulties exposed by the students was: the lack of reading practice and researches.

According to the student´s dificulties, activities were made to help them to work in group, to destroy the mith of reading and no understanding economy na that helped to wake up the search for new information. Those activities were made along the discipline and related with the subjects that were being given theoretically in room. They are them: search of papers in the local newspapers, exhibition of the researched subject and the way as it was understood, seminar done group, search of information in the Internet sites about economy, discussions in room on the professional's paper inside of the company and the importance of the knowledge about economy in the taking of decision, assembly of themes of the discipline in modules to be structured in language adapted for Internet.

The activities seem simple and already known, but they transformed the discipline into a forum of discussions and creation of didactic material. That is an accomplished similar experience in the Department of Civil Engineering of the Federal University of Bahia where the students participated of a project that involved some disciplines in a city of the interior of Bahia (Santana,Cobenge,1997), in the discipline of Quality in Santa Catarina's Federal University (Palladini, Cobenge,1997) and other experiences that are being accomplished and debated in Congresses on teaching in Engineering.

4. Results

The discussion generated around the theoretical concepts of the economy and of the economy applied in the daily of the country lifted change needed in the posture of the future professional. The lack of experience to face practical problems and to take decisions based on the knowledge accumulated along the course turns defensive and apprehensive the students when confronted with their engineer responsibility. That picture cannot totally be modified, the need to look for new and complemental knowledge is some of the first answers obtained in the discipline.

Each activity had a specific objective and a practical objective. For example, the research of texts in newspapers helped the students to learn how to research, to know current subjects and express their opinions. Some activities generated projects to be developed in future disciplines. As the application of company games for learning of the module Production in microeconomics.

There are many concepts about games:

"Simulation game is an educational alternative, guided for the action, centered in the participant, in order to foment the learning, in an opening atmosphere." (Ramos apud Adams, 1991);

"Simulation games can be defined as any simulate competition among several opponents, operating under restrictions, for an objective." (Ramos apud Gordon, 1991)

" Games are dynamic models of the reality. As all the reality models, have high truthfulness because, as process, they demand a clear explanation of the reality. They reproduce, more quickly, with the smallest possible danger and results you observed, what happens, in comparable situations, in the real world." (Ramos apud Adair, 1991)

The games are always old tools associated to children and in the history associated to money. The games are part of a larger group of tools: the simulation, where the reality can be projected to be analyzed, modified, tested without existenting risks in the real models. The games are more complex than the group dynamics because they present more complex situations and they could be modeled in agreement with the existent need. They are used for executives' training, planning of products, planning of manufactures, process improvement, development of managerial abilities and other activities.

The games are very used in managerial training, training of war tactics, but not very well-known in the universities enviroment. It is a powerful tool. The main characteristic in a game is to make the students take decisions more and more close to the reality, as long as they learn about represented process. Through the game it is possible to show the operation of a company and the consequences of the decisions takings. The experience brings reduction it possibility of mistakes.

The proposal of using that tool was made by the students and it should be part of a module of the discipline. After knowing theoretically how the economy of the country works and understanding how the production process works and its influence in the economy, the game could work as a complemental point of the knowledge.

The modifications of the discipline of Economy were also done in the didactic material presented by the teacher. The students built modules in Toobook (software that has creates mltimedia applications) to present in class room. Those modules were introduced as tool of search of information and in some cases they should substitute the class given by the teacher. The researches, done by the

students, were revised for later to be transformed into modules and used by other teachers. Those are some of the results obtained in a discipline that should not be part of the engineering curriculum, according to the students. They were simple ideas, but with the help and creativity developed by the students it generated a big amount in new teaching ways with the existent resources.

Conclusions

New engineer profiles are demanded in the labor market. The engineers should have conditions to survive and to develop in this era of constant transformation of the knowledge. The demands going besides the technical knowledge, they are demanded managerial abilities and other knowledge that changes into a special professional.

The introduction of new teaching methods is important for the growth and development of the professionals future. The discussions make the students to rethink themselves as professionals.

Our objective was to show a simple experience of change posture, with given tools and created by the own students.

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