# Chemical Engineering Distance Course: The pioneer experience of Catholic Univesity of Rio Grande do Sul, Brazil


## Authors:

Eduardo Giugliani, Catholic University of Rio Grande do Sul, PUCRS, Brazil, giugliani@pucrs.br
José Nicoletti Filho, Catholic University of Rio Grande do Sul, PUCRS, Bramiu, nicoletti@pucrs.br
Gerti Weber Brun, Catholic University of Rio Grande do Sul, PUCRS, Brazil, gerti@pucrs.br
Rubem Mário F. Vargas, Catholic University of Rio Grande do Sul, PUCRS, Brazil, rvargas@pucrs.br



***Abstract*** *— The article present one of the first projects of development and implantation of a Ch emical Engineering Graduate Course using the Distance Learning Education modality, emphasis in Pretrochemical, in Brazil, implemented by the College of Engineering of PUCRS. The pr oposal of the Course originated in the Petrochemical Industry, with the purp ose to serve the pe rmanent demand of qualification of this sector of the industry, in order to have a competitive differential. The implementation of the Course aims to qualify potential st udents, already with high technical level, in several Petrochemical Poles of Brazil, primordially those who int egrate the Petrochemical Pole of Triunfo, in Rio Grande do Sul State. The proposal embraces an e xtensive training of the lecturers, in order to unable them to use the new teaching tools, to properly prepare the s upport material for the students, as well as permanently advise the students.*

*The present work originated in an Engineering Graduate Education unique experience developed at PUCRS until our time. It is based on a project that meets the interests of an ente rprise of the Odebrecht Group, BRASKEN Petroquímica, a frontrunner in the petrochemical scenery in South America, translated to a Chemical Engineering Graduate Course – emphasis in petrochemical Operation – in the Distance Education m odality.*

*The elaborati on of the project took about eighteen months and envolved the ac ademic and technical staff of the College of Engineering - from the fundamental areas, such as mathema tics, physics and chemistry, the human areas, such as philosophy, education, psychology an d foreign languages, to the specific technical area of chemical engineering – jointly with the represe ntants of the technical and human areas of the company.*

*The proposal of the programm was consolidated by a multidisciplinary team, which started up identi fying the profile of the professional to be formed. This profile was formed through the development of the competence, skills and attitudes desired in the pe rformance of the professional activity. The fund amental goal of the proposal is to qualify professi onals for the work market, once the target are professionals who perform the duties of industrial process operators and whose technical training is medium level now adays.*

*The article presents the elaboration of a program proposal sustained by a pedagogic a pproach that fits the purposes and inherences of a form of education in which only 25% of the activities are carried out in the presence of the tutor, being the remaining activities done at distance. The requisites for the achievement of the proposal as we ll as its contextualiz ation are demonstrated step by step, mainly to show this concrete experience as the deep change that happened with all the teachers, when they needed to change their way of teaching. About the results, this article demonstrated the ne w profile of the students and teachers after the implement ation the first half part of the course and also report same advance in using this new tools for learning.*



***Index Terms*** *— Design Education, Distance Learning Education, Engineering Curriculums, Hype rtext, Innovator Curriculums, New Paradigms, Virtual Learning*


## Introduction

Nowadays, society has been questioned by a context, in which technologies cross our daily life in an irreversible and inexorable way. The migration to a world more and more connected in networks and the culture which sets up independent of individual or homogeneous groups wills impose, in an indelible way, the necessity of including oneself in this process so that one can be an active agent of today. In this scenery, education is not immune, untouchable by such a movement, technology invades the environment of learning production, affects the manners of the teacher's being, claiming for transformations in order to account for a new population very much impregnated of a world network culture. In this context, distance learning gets a different breath and it is showed as a powerful modality in the sense of promoting learning. So, we notice a fast and

vertiginous growth of the offering of distance courses and programes all over the world and in Brazil, not only as a supplementary process, but mainly as an institutionalized learning structure, being it national, foreign or both. In Brazil, differenced organizations, such as SENAI, FEPLAM, PETROBRÁS, Roquette Pinto Foundation and Pe. Anchieta Foundation has been developing experiences in this field. It is relatively recent the involvement of Higher Educational Institutions (HEI), as a systematical action and of a certain importance, such as the ones developed by the Universities: UFMT, UFSC, UNB, USP, UNICAMP, PUC-Rio, PUC-Minas and VIRTUAL PUCRS.

With the approval of the Directresses and Basis Law, in December 1996, the Ministry of Education brought the legal perspective, for the Brazilian Universities, to offer different forms of education pointed towards Brazilian youth and adult population, increasing the offering of courses in technical, professional and academic qualification in Distance Learning Education in its varied graduations.

PUCRS, Catholic University of Rio Grande do Sul, aims to guarantee the quality of learning actions, using the most modern and efficient technologies of distance communication. The organization of learning environments in distance modality implies the usage of tools with the aim of helping the teacher in the learning process.

For all this, PUCRS is engaging its staff in the planning of activities, which involve necessarily the individual and collective learning process, the permanent qualification and formation of teachers and the emphasis on the student as the real subject of this process. Joining to these challenges is the absence of the student at the campus most of the time, as well the many places and different schedules where and when they are and should be attended. This tendency is imposed by the great number of adults and youngsters who, all over the world, have been looking for differenced ways of improving their abilities and capacities, as well as their professional and academic formation.

## An interlacement among multiple alliances to build the same objective

The partnership firmed between PUCRS and the "OPP Petrochemical" (nowadays, "Braskem S.A."), through a convention of cooperation and technical-scientific interchange, signed in 1998, aims to make possible the continuity of professional formation of the employees of the accordant firms, letting them work by turns. To make this experimental project, we can count on the participation of other units of PUCRS, besides the College of Engineering (FENG) and the VIRTUAL PUCRS.

Answering to the human and technological demands, the project of Distance Learning Education, object of this article, in another alliance established between the Engineering College and the VIRTUAL PUCRS, receives the credentials from the National Council of Education, being homologated by an act of the Ministry of Education in 2001. The project is implanted, this way innovating and aggregating values to teaching and learning when it couples dimensions linked to the technological advance of the digital age, allowing this way the enlargement and socialization of knowledge. With this initiative, multiple possibilities of knowledge access are opened for people who have been distant from the traditional poles of information offering and up-to-date academic formations [1].

Education is the basis for the development of the people, organizations and communities. The competitive challenge of the companies is to integrate and form learned people able to transform their intelligence in richness for the clients and communities, besides the search for enabling people to make decisions and increase the technical level of the ones involved, so helping in the personal and professional development of the components.

## The course and its pedagogical project: some knots of a net

The main reason to implant the Distance Learning Education Course, DLE, is to allow the continuation of the professional formation process of the conventioned company employees, who work in a system of variable turns. As these turns are not permanent the traditional teaching is not favorable to these workers. A disrespect to this reality makes it not possible, in a way, for the human and technical qualification of the professional who are in this work situation, disregarding very much the human promotion and the technological condition of the company itself [2].

The course was planned considering basic requisites, having in mind the construction of competence, abilities and attitudes by the students, attending to the National Curriculum Rules in Engineering, and also in agreement with PUCRS purposes, as a Marist and catholic entity, but, above all, as a University that aims reaching the knowledge frontiers, critical-reflexive actions of these same frontiers, besides a solidary and independent proposal for itself, for the social groups and for the society. Add to this, the fact that the pretended formation is turned towards a segment of Chemical Engineering, that is, Petrochemistry, which assumes the deepening in studies related to processes and operations practiced at the so called industries of first, second and third generation of transformation of products derived from petroleum naphta [1].

The pretended type of functioning is distance learning education with 25% of presence activities corresponding to, at least, one monthly meeting for each discipline. Such meetings cover, not only evaluation processes, but also practical laboratory activities, seminars and integrative activities among others.

The course has an expected length of six (6) years, totaling 3600h, searching for the outline of a Chemical Engineer profile. Nowadays, we observe alterations in the profile of the engineering professional caused by the changes at the work market, the influence of new products, services and materials, and yet by the absorption of new technologies. Inter- (Trans)-multidisciplinary and systematic and systemic planning perspectives are more and more required of the Engineering professionals in the sense of adapting active and critically to new models of modern society.

Facing this, we identify the necessity of preparing flexible, creative and critical professionals turned to the new work relations, to the enterprising character and to the independent activities, observing ethical-social aspects turned to the importance of the profession in the society as a factor of social and economical development.

As expected competence of the Chemical Engineer come from the course, it is desired the construction of a theoretical and practical knowledge consolidated in a basic and professionalizing specific level, translated into an installed capacity of thinking and creating problems and solutions related to Chemical Engineering, allied to the development of management abilities intermediated by interpersonal relations.

In terms of abilities, we search the development of capacities to:

Leadership and team work;

Oral and written communication;

Concept and process, product and system analysis, using adequate models;

Planning, supervision, elaboration and coordination of petrochemical processes and projects;

Management, operation, optimization and maintenance of systems of petrochemical industry;

Mastery of computer technologies and of other tools for the exercise of the engineering of petrochemical processes;

Critical view of the orders of quantity in the solution and interpretation of results in engineering of petrochemical processes;

Reading, interpretation and expression by graphic means;

Development of practical activities, analyzing and interpreting results;

Understanding of cultural, socio-economical, legal and administrative problems;

Consciousness for the necessity of compatibilization of the technology with the preservation of the environmental resources, promoting the maintainable progress.

Allied to these capacities is the compromise with the professional ethics together with the awakening and engagement in terms of environmental, politics and social co-responsibility. The development of a pro-active and enterprising attitude is also pretended in order to keep oneself conscious and engaged with the permanent search of modernization and professional improvement.

Aiming to account for the emphasis in petrochemical operation, the professional we want to form must dominate the contents related to the knowledge of materials and processes of the 1st. 2nd. and 3rd. generations of petrochemical area, as of the equipment in its conceptual basic project, allied to enterprise and environmental administration, associated with the knowledge of control and instrumentalization.

The action in DLE (distance learning education) presents some characteristics related to our educational paradigm and to the nature of the specific process. It involves, as it has already been defended by Gunawardena and Zittle (1998) [3]: a teaching centered in the student, which brings deep transformations in the learning and, also, in evaluation processes.

As to evaluation, it is understood a processual and continuously associated with learning and not with the control of learning. The evaluation process is also an integrant part of the whole pedagogical process, being organized and discerning so that it can reflect the critical and intellectual evolution of the student. In this proposal the evaluation includes attendance and participation in seminars, moreover: theoretical and practical tests, visitings or laboratory reports, theoretical-practical exercises, extra-class works, performance through Chat, performance in groups with discussion of subjects, solve doubts, among others.

So, the experiences in DLE have assumed, during its enlargement, different approaches which go from an emphasis on information acquisition and transportation to an approach centered on the learning of meanings, in a constructively perspective (Medeiros et al. 2001a) and, in this case, adjusting themselves to our proposals. Learning, also in DLE, is absorbed much less as a transmission of information, but much more as a facilitating process of sense exploitation and creation through cooperative actions [3] [4] [5].

The pedagogical project of the course at issue is based on interactivity, cooperation, cognition, metacognition and the promotion of the autonomy of the social actors involved in the process, in a proposal centered on learning and reflection, adequate to the purposes of VIRTUAL PUCRS. In the Chemical Engineering course, in this modality (DLE), we aim to attend to these rules, since the moment it is planned till the evaluation, monitoring and feedback.

## Topology

The pedagogical architecture adopted for the referred course uses satellite band for the generation of videoconference and teleconference, as well as a 24 hour daily support, by Internet, where the course site is available. It is added the use of WebCT (Web Course Tools), a learning environmental organizer and manager to this hybrid platform, as well as the possibility to use openly the line 0800 and conventional dialed lines. The recuperation of classes, presenced or transmitted by

satellite, by the student, was made possible, initially, through videocassette tapes and, nowadays, through CD-rom for the ones whom, eventually, can neither participate of the videoconferences nor in presencial modality classes, if this is the case. Each student, in the same way, can access the previous classes through the Course site in the web, made possible by video on demand. Besides this, there is an open channel in different schedules for assessment and monitoring by the teachers, monitors and tutors [2].

So, we work with the idea of integrated media and, beyond them, searching for pointing certain characteristics and dimensions implicit in our way of being and configure meanings, conditions of great significance, such as the necessity of establishing contacts, of enlarging affective links with emphasis on the image and voice of teachers and students – actors of this process - of the importance of the "eye in the eye" even if they are distant in determined time and space. We are conscious of the conditions that are imposed by the decision of privileging the use of telecommunication, as well the videoconference and teleconference, to the attendance of the expected "just in time", so wanted by everyone, especially in DLE. In the same way, and, paradoxically, it is evident the necessity and the expectation of people in searching for capacity and information processes. The number of these people grows in an exponential way, especially in Brazilian reality [6].

The choice for the topology which regards the usage of VIRTUAL PUCRS satellite platform considerated factors such as accessibility, that is, the access possibility of the "last mile" student; addressability, the condition to arrive to places and people, considering the difficulties of transmission of data and images exclusively through Internet; resolutivity, as the condition of being able to generate, to transfer data. images and sound, and, in the same way, receive them with quality, in which speed is included; of interactivity, permanence, transparence, sharing and of terminality [6].

So, the frame of the work developed by this group is based on some postulations such as: (1) the emergency and institution of a reality, centered in the proposal of a continued education as a permanent learning process; (2) the effort concentration to make teaching more centered on the student, considering education as self-managed, is focused and demands more appropriate means of mediation of the professor; (3) the desire and the necessity of giving the access to information in differenced time and places, according to the needs of the pupil; (4) the development of knowledge media which describe telecommunication convergences, computer processes and the cognitive sciences, in which are included the capture, the storing, the sharing, the access and the creation of knowledge and, finally, but not less relevant in our view, the necessity of working questions related with the development of autonomy in the differenced processes and steps of Distance Learning Education.

## About the trajectory: a trip through some plateaux

The Course began in the second semester of 2000, with the student entrance through "vestibular". In its eighth semester, the CED, its actors and multiple activities, sets up creation spaces on which one can discuss, negotiate, renegotiate, having the qualifying construction of learning as one of the expectant duties.

In this course, at least four large plateaux are identified, in the excerpt proposed now, set up on constitution movements and transformed through argumentation, characterized as zones that keep steady, even under the action of movements, internal or external, yet provisorily stable. These plateaux are named here as of Inauguration, of Hypertextuallity, of Flexibilization [2] and of Appurtenance.

The opening plateau - The first semester of the course was marked by the perplexity of the entrance in a new world. The involved social actors were capsize interpellated for demands which were previously non-existent and potentially/concretely invasive that had modified their routine, even if that demand has been provoked by them. The students - adults that moved away from the school banks for years - the introduction of more hours of activities in their life disorganized familiar, social and personal routines and habits generating tension. The decision to participate in a course in DE contained, in an implicit way, easy expectation that did not materialize, once the requirements to attend the five disciplines concomitantly and obligatorily were huge. Moreover, the demands that were formed of technological domain of working tools had constituted a challenge that not only deterritorilized the students (move them away from their old patterns) but also the professors. It can be spoken here of an acute and dramatically moment from which it became necessary to extract the construtivists/construcionists potentialities to make appear something new that allowed the emergency of a new plan with consistency capable to liberate itself of the problematic determination to open itself for problematic of the possibilities.

According to the challenges proposed by Habermas, we search for setting up in this learning community public spaces that really privileged the free speech, since it is well-founded and discussed, having the intersubjectiveness processes respected [16].

By means of dialogue and argumentation, as well as the certainty of inclusion of the different, an alternative was constructed that dilated the period of development of disciplines, as well as finished with their development concurrence and strengthened the attendance of the tutors and advising of the professors. It is also important to mention, as it refers to actors/professors, on this plateau, a situation where, due to the planted experiences of the presence course allied to the opening to the unknown and new where one has never passed through, the hypertextuallity has been configured and in an incipient form, in the tracings that were showed. Moreover, the stage of the monitoring of the learning process occurred in a laborious form, what deviated to a certain extent the forces of the

professors and their team, in the search for the hypertextuallity directing it to an (almost) manual processing of monitoring. As to the materials, while they pointed to the migration of was intended in the project of the course, they did not reach the desired platforms.

The hypertextuallity plateau - From the analysis of the displayed decisions had been previously taken so that another route is undertaken in the direction of the promotion of what was understood, as being better to the groups. Then a software of management, WebCT, started to integrate the environment of the course, what has facilitated the monitoring process, but not only this, as the advising/tutorial understood as a support to the student, was widely proliferated as a view of the communication tools, such as forum and Chat, that had started to integrate the pedagogical architecture of the course. This also came to corroborate in the direction of display more time to the professors to elaborate the materials. In another dimension, the students who were participating of these environments start to act in a sharing way, which is one of the guidelines for the paradigm adopted by PUCRS VIRTUAL.

Alternatives had been created to facilitate the migration of the professors in the direction of constructing more adequate materials to the means and to the ways which were offered, consisting then in workshops where questions as virtuallity, potentiality of this environment, hypertext, multimedia, and hypermedia were worked. It is important to detach that this molecular movement, while course of chemical engineering, made to occur a molar movement, while PUCRS VIRTUAL, which started to adopt in the teaching qualification courses in education in the distance, activities focused in hypertext, either under the theoretical aspect as under to the construction of such materials aiming to constitute a skill in those participants, but also passed to adopt another tracing where in its own materials this character of hypertextuallity started to draw itself in a frequent and intense way [5].

The use of cartoons, figures, texts interconnected in hypertexts used as an agent in the learning process amidst to the videoconferences and the interventions that make use of the communication tools as chat and forum, had extended in multiplicity the constituted environment of learning, transforming it. Such mutations also reverberate obviously in the learning carried through by the students, who observe the search on the part of the professors of other platforms of quality, demonstrating a commitment with the course. Thus, feelings of belonging were stronger in the students; commitments with their learning were strengthen, what favours the knowledge production that is one of the objectives of the process. It also constitutes a dimension of this plan of learning production, the use of hypertext, which also results in constitution, the aiding to multiple intelligence, and therefore to the multiple forms of learning, in the direction as Gardner presents it, and also the easiness that the material, in this mutant format lodged in the ned, privileges the multiplicity, in the rhyzomatics direction pointed by Deleuze and Guattari but also in the direction that Edgar Morin with the paradigm of the complexity points to us.

The flexibilization plateau - To accomplish the migratory movements in the search of the flexibilization that has become an emergent necessity, a deeper analysis becomes necessary, in which the sweepings field is not focused, but scrutinised in its diverse nuances and constitution. To this end, attention was not only turned toward the promoters of the learning environment but also and simultaneously to the involved agents as well as the surrounding where the process occurred. Thus, immersed in a transient process between a presential culture and a virtual one a delicate period of training of the process was lived that demanded monitoring/advising and prospection, aiming itself to promote the success of the learning process. Although the change trend pointed signals of virtualization identified with in the relations pupil-professor, pupil-pupil, as well as pupil-technology and it was evidenced the presence of desirable and necessary dimensions for the effective remote learning by means of interactivity indicative, co-operation and autonomy, observed even in the environment as in the individuals thorough the process, the architecture presented and offered to the pupil did not contemplate spaces of freedom in the formularisation of their resume. At this moment the pupil followed a foreseen obligatory curricular series for the accomplishment of the course. This paradox that was presented in the practice of such course disturbed the agreement one has of a process conducted by the paradigm of Education of the PUCRS VIRTUAL [7].

In the light of social-technical-political-cultural movements of the contemporaneity, such as the globalisation, the after-modernism, the dilution of borders, the deterritorialization among others boosters of today's world of, the man of this era is seen immersed in multiple currents of thought, that constantly defy him with relation to the updating, the selection of information, the use of new technologies and the positioning before humanity. Far from distant periods where a chain gave direction to the thought of the time, today, the intricate relation between different lines of thought makes the person guess and be located in order to make more distinguished and multiple choices, receiving and integrating some sources of different origins, carrying through their own provisory and mutant syntheses. The direction of this particularity of positioning is the individual interpretation of each movement as well as the negation of another one, or same part of another one.

Then, the person is faced to a situation where knowledge and actions twist themselves, and thus, a rigid and plastered resume does not match with the reality of today's students, which sends to him to search of a resume where flexibilizations does appear, and contemplate the differences to promote learning. As a to-be-formed professional, one does not expect only the skills techniques, but a set of other abilities that include intuition, flexibility, creativity, capacity to work in group and preparation for permanent updating, the conditions in which the formation of this person is done and cannot be in contradiction with these goals.

In this plateau, in which we are inside, freedom spaces had been restored in three main axes: the magnifying of the number of offered disciplines, the school registration for disciplines, the implementation of modulated disciplines to attend the different rhythms and conditions of learning of the participants. While the moment, the CED (chemical engineering by distance) course has only one group, the number of disciplines was extended not only following the regular systematic of implantation of courses that foresees the edition of disciplines as the course goes on.

Thus, it was necessary that the range of the offered disciplines were extended so as to take care of recovery of the offered disciplines in which the students had not obtained approval, but magnifying the spectre of already offered disciplines in order to make possible the composition of different plans of studies. This magnifying comes on a gradual form, until completing the entire foreseen resume. Thus, it was possible to recover, modify and anticipate the learning, attending the demands and rhythms of the students.

Collaborate with this perspective, the displaying of modulated disciplines presenting them in a complete form and in modules. This display implies the description of actions, as in respect the pedagogical processes, contents, materials and plans as to the processes of learning evaluation and certification of the student. The display of modular disciplines implies on the division of the program content in independent units that can be sequential or not depending on the nature of this content. In each unit a main concept or concepts is/are privileged that justify the insertion of the content in the whole discipline. The mapping of these concepts, the conceptual map, serves as reference for the structure of the units.

Appurtenance Plateau - Nowadays the course is settled in a perspective that is called Appurtenance. After surpassing the initial difficulties of insertion and adjustment with rhythms and ways of being and living in DLE, the social actors, professors, monitors, tutors deal with the quotidian, with lower anxiety level, being able to recognize and to operate technical and personal resources in themselves as well as in other people, creating, effectively, efficient communicative and interchangeable nets. This does not mean that, in any way, this plateau mean stagnancy. This plateau refers to the feeling of making part and, when experiencing this position, which implies on perceptions, affection and cognition, be able to operate chains of events that break out creation and learning. Evidently, the institution of such a plateau is a product of the reach, yet partial, of some of the course objectives, referring to the creation of an atmosphere favorable for learning as also to the development of desired competence and abilities of the profile outlined for the egress. It is important to point out that these abilities and competence are produced in the union of the composing elements of the atmosphere that include the singularities not only of the pupils, but also of the teachers, tutors and monitors, their productions and interactions.

The fluidity set up in the project of the distance Graduating Course in Chemical Engineering is presented with high freedom levels for also having as a presupposed guideline the principle of flexibilization, basis for the more effective institution of what we call and identify as appurtenance. All the arrangements materialized in established plateaux have been done through the process and were unpredictable at the moment the course started. The decision of promoting the suggested changes came supported on a decision about priorities. The learning priority should be necessarily kept, it means, in our point of view the only strictness was on the production of learning, all the rest around this position could be modified. The adopted modifications were set up from public discussions, in which the participation of all the involved agents was made possible at the same time it was stimulated. So, an action that is not characterized for letting it floating along, loose, but for constructing learning in a collective and individual way, constitutes the basis for the emergency of actions instituted in a continuous game between an explicit establishment of rules and a rising of flexibilization processes, in continuous articulation [2].

We should say that the evasion rate is high, today, about 70%. Such a percentage was reached practically in the beginning of the third semester, due to situations discussed in the Inauguration Plateau, allied to changes occurred at the company in respect to its market and in respect to its posture towards the course.

The literature of the area, especially the one which comes from Fern Universität, in German, points to these high rates at the beginning of the graduating courses, as well as to the search for return, after some period from the beginning of the courses. According to studies of researchers in this area, it is due, partly, to the maturity of the student as well as his/her entrance in the virtual culture.

## A virtual world to produce chemical engineers

A virtual learning environment is conceived as an organizational structure open in net, having as focus the total formation of the human being as a participant of social groups, where the teacher, but not only him, performs the role of manager/guide/mediator and this is consolidated at the moment the communication processes are set up, for actions of multiplicity, of co-authorship, of operating with the other [8]. When we speak about virtual environment, we share with Deleuze and Lévy the understanding of the virtual as something in potency, we do not deny the possibility of the real to the virtual; if the virtual has an opposite, this is the actual [9] [10]. Monitoring mechanisms and administration, executed by the teacher, were given to the virtual learning environment. Such attribute is consolidated as the communication processes are set up.

The virtual environment built for the course EQD is constituted of an open site, published in the web, where you can get into private environments, (http://cursos.ead.pucrs.br/eqd), where each one of the disciplines of the curricular grader stays. Accessed through password, they stay in an environment manager, the WebCT. The videoconferences, available in CD-rom, integrate to the web, in case of the pupil's participation, for some reason, is enabled at the moment of the generation. This would be a resumed description of the virtual learning environment of the EQD, but clear enough in order to be visualized here.

A discipline put in the Web-CT is structured from a main site, where different tools can be arranged according with the wanted characteristics, preserving the individuality of the teachers' proposals, as it is exemplified on Figure 1. The tools available in the Web-CT are classified in: contents of the course and their associated tools, tools of communication, tools of attendance of the pupil's trajectory, sites/URLs, pupil's and administrative tools [11]. The didactic material, relating to the presentation of the contents to the student, is made mostly in hypertextual form.

In the established perspective, as well as in that of Piere Lévy (1993) [12], the hypertext has its best description and theoretical representation in the rhyzome. As a support of organization of information, the hypertext is tool-instrument of expressive importance in an educational proposal crossed and transversalized by Technologies of Information and of Communication, as in the case of the Program of DLE of VIRTUAL PUCRS, assuming the condition of an interrogator of projects and concepts of learning and teaching of the social actors involved in the process – teachers and students - a real war machine, according to Deleuze and Guattari (1995b) [12].

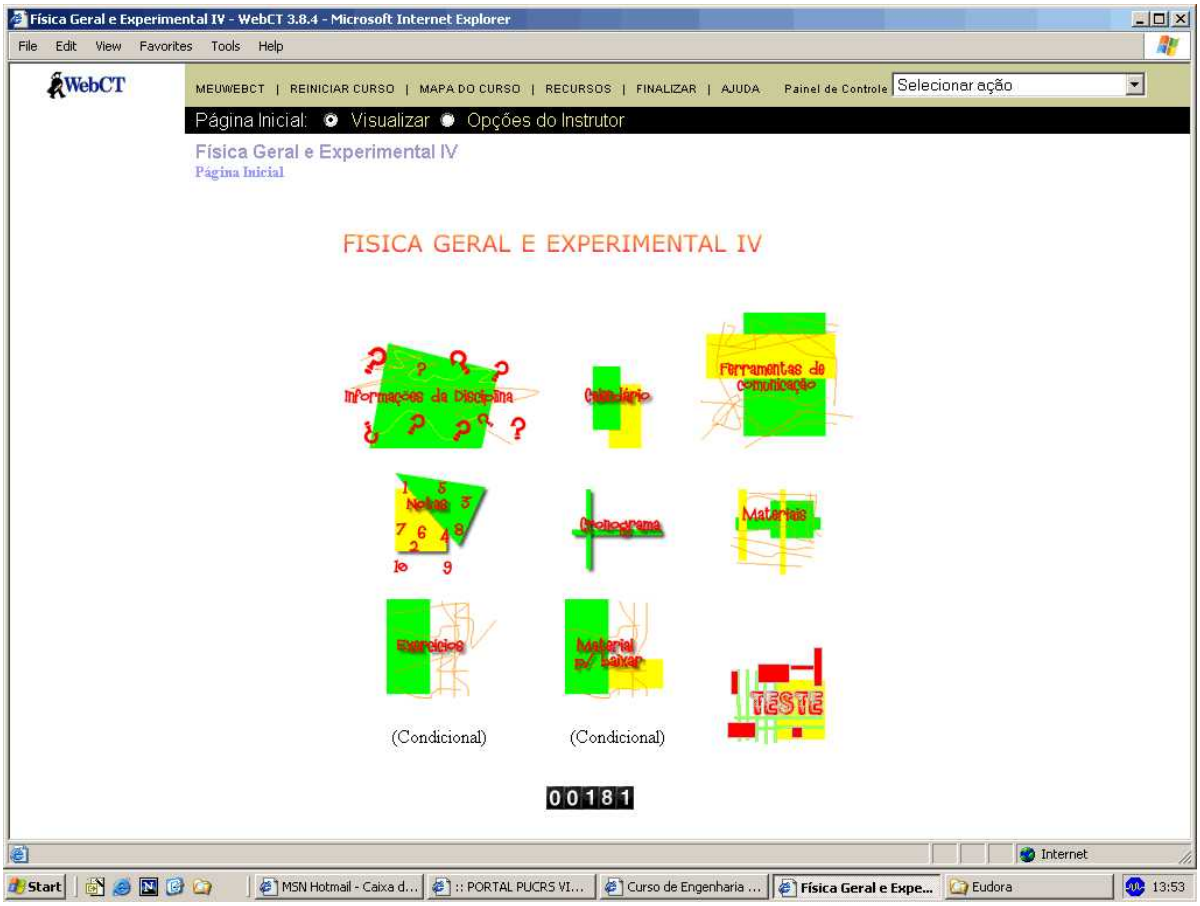


FIGURE 1
INDIVIDUAL SITE OF A DISCIPLINE HOSTED IN THE WEBCT

The hypertextuality gives form to an old demand of building learning in different ways, attending to cognitive styles of the learners because it permits, at a single touch, the access to expression forms differenced of a same concept, as it is exemplified in Figure 2. When we permit/give access/facilitate to the learner ways of expressing a certain concept, not only those that a teacher is able to translate, bridges are built for helping the individual to build his own concept, what constitutes an expression of multiplicity so wanted in the educational process [14].

It is conferred to the hypertext the quality of hypermedia, at the moment when there are many media inside its body. In the EQD course some didactic materials, searching for the production of meaningful learnings, incorporated animations among texts (written), figures and graphics (image) originating virtual laboratories.

The hypertextual form of the available material gives expression to the size of the educational paradigm of the course. As to autonomy, the student himself chooses the ways according to his momentaneous conditions, the links to be seen, going towards the construction of his own knowledge, watching metacognitive and cognitive processes. The communication tools consist basically of forum and electronic mail (assynchronal) and Chat (synchronal) available in the environment, through which it is promoted interactivity among the components of the process (professor, pupils and monitor). The forum usage starts a web of knowledgement construction, in a cooperative way.

Colaborative tools are fundamental instruments for establishing linkings among the participants, cause they create

conditions so that pupils, professors and monitors may know each other, recognize and develop affective relations which, even if they are not “eye in the eye”, they set up and proliferate, re-signifying and questioning all their components in the production of understandings of human senses, which enlarges the dimensions of the sense consistence planning [x] (Deleuze and Guattari 1995a).

Other available tools at WebCT refer to the monitoring of the process, regarding to the pupil, as well as to the professors. Such devices speak about the moments and amounts of accessing to the various materials. With this, the professor will be monitoring the learning process, re-guiding routes in individual as well as collective level. Obviously, these are not only actions deflagrated from this unique indicator, but insert in the context of many other indicators.

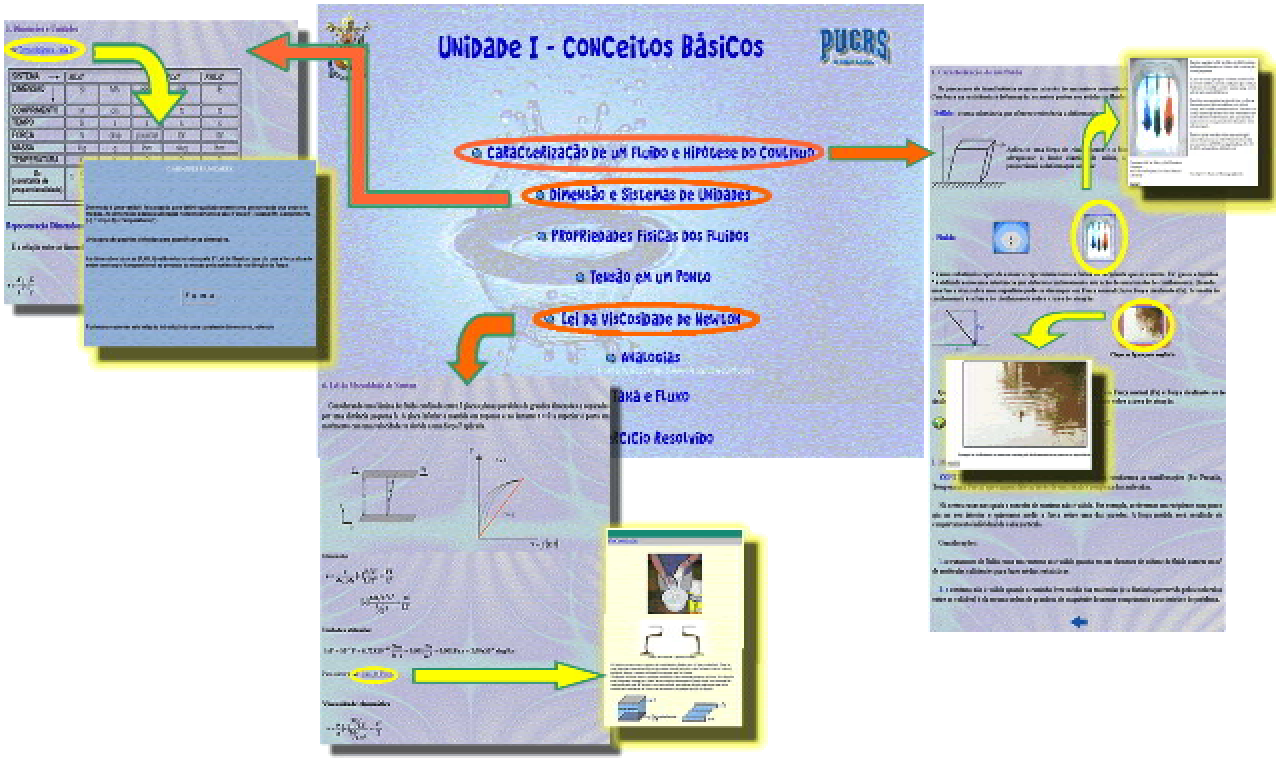


FIGURE 2:
HYPERTEXTUAL MATERIAL USED AT THE COURSE HOSTED IN THE DISCIPLINE ENVIRONMENT

There is also the possibility of self-tests available for the students so they can check their performance, as they feel prepared. We point out that, in DLE, the monitoring, understood as the attendance of individual traces developed by the students through the way and the process as a whole; and the tutoring, understood as the supporting for the preview and unusual demands, result or not of the monitoring, are decisive for the success of the learning process. The usage of cartoons, figures, interconnected texts in hypertexts used as agents in the learning process, among the videoconferences and the interference through communication tools like Chat and forum, enlarged the environment of the conventional class, making, creating a new place that aims to learning; this place shows up as a virtual world to produce new chemical engineers.

## Conclusions

In general, courses at distance are presented with bigger flexibility, as a possibility of the pupils to elaborate plans of studies according to individual criteria. Moreover, the public who is part of the constitutor group of the demand of this course is a professional group that lives the contingencies of a life space differentiated of that usually constituting the population of the presential courses. The investment demanded for the opening of this course is not justified only in view of this population, but also, other public, beyond the proper constitution of a relative knowledge of the virtual dimension that also extends itself to the presential dimension. In the specific case of the CED, the implications are already felt in the curricular reorganization and the pedagogical project of the actual CE; they are experiments like that of creation and enlargement of the offering of virtualized disciplines, for differenced modalities of students and

interests on the different graduating courses of Engineering besides distance Chemical Engineering, reterritorializing other sectors. It is the molar (the general, institutional), in this dimension, being instigated by the molecular negotiations and enunciation (microphysics, micropolitics) of individuals and groups of this course [15].

The flexible character of the proposal, the disconstruction of the conception itself of paradigm, accepting it as fundamentals, however undergoing reverberations of its foundations, covering itself with other layers which make it different although the same, leads us to believe that the constructed virtual world will produce chemical engineers, different one from the other, even if all of them have passed by the same process. Respecting their individualities in a process of self construction ("autopoiese"), the excavated tunnels, the climbed mountains, the crossed rivers, the navigated seas were not the same for all at the end of the graduating stage. And at this point, when turning back, looking at both sides and ahead, conscious that everything has not completely been perceived and that there is still much to perceive, that the individual may say he is an engineer, a Chemical Engineer.

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