

TEACHING OBJECTIVES: COMPETENCIES OF THE ENGINEERING PROFESSOR

Ivete Ana Schmitz Booth

Universidade de Caxias do Sul

Olga Kubo e Silvio Paulo Botomé

Universidade Federal de São Carlos

Abstract: *In order to know the teaching behavior of the Engineering professors it is necessary to answer: (a) what are the variables that constitute the teaching behavior of the professors? (b) what are the characteristics of these variables? (c) what are the possible variables that determine the characteristics of the teaching behavior of these professors? Research on these questions is important for the engineer-professor of the Engineering Programs to overcome some teaching problems that exist in this professional field. The identification of the variables that interfere in the teaching behavior of the Engineering professors may identify gaps of knowledge that need to be fulfilled. The production of knowledge on this issue helps these professionals to question their behaviors, review concepts, and develop new professional behaviors, expanding the opportunities for them to work. The new findings probably will create better conditions for the engineer-professor to develop new teaching behaviors in the academic environment, leading to the preparation of competent professionals, updated and adequate to the needs of the society. In this study, 17 engineers-professors working at the University have been interviewed about topics such as planning for teaching, decision on course content, and teaching and learning conceptions. The results highlight the need for a more precise conception on planning for teaching and a sounder pedagogical formation to teach at the college level. The data allow to derive specific actions for conceiving intervention programs, which can be used to redefine the teaching behavior toward concepts related to the planning for teaching in order to compensate these deficiencies and to minimize the influence of the variables that determine them. The data also allow to derive proposals for the improvement of teaching in Engineering at the graduate level and to design programs for faculty development at Universities.*

KEYWORDS: *Teaching behavior. Competencies of the Engineering professor. Teaching-learning process in Engineering. Quality in education. Teaching objectives.*

1. CHARACTERIZING CURRENT TEACHING

The participants of the 1994 Seminary of Engineering Teaching Reformulation were representatives of Engineering colleges (course coordinators, college directors) from all over Brazil and Uruguay. The aim of the Seminary was to propose guidelines for the curriculum reformulation of Engineering courses and it also pointed to the necessity of improving the didactic background of engineer-professors, as can be seen in the synthesis of the three workgroups: a) fostering the pedagogical qualification of graduation courses university teachers; b) fostering the university teachers' didactic-pedagogical training; c) deeply changing university teachers' attitude by leading them to constructing new pedagogical relationships with the students - to learn how to think in a new didactic conception that stimulates the student to critically and creatively face the problems of his/her professional universe, including social and educational areas; d) formulating personnel policies, i.e. qualification programs for university teachers - to form again not only scholars but also teachers.

Another characterization of current teaching can be done by generally examining published papers in the Annals of the Brazilian Congress of Engineering Teaching (1994 and 1995) promoted by the Brazilian Association of Engineering Teaching. This examination indicates that a meaningful amount of papers discuss aspects related to Method and Didactics for the teaching of Engineering and Reform and Adequacy of its curricular structure.

From the almost 80 papers published about the subject Reform and Adequacy of the curricular structure of our Engineering courses, most of them suggest changes in the curriculum in order to incorporate new disciplines or to alter disciplines to better meet the demand of the market or to meet legal and bureaucratic requirements or, still, to serve a specific field of action (Longo, [1]; Cordeiro and Giorgetti, [2]). It seems, generally, with rare exceptions (Amorim et al., [3]) that in order to solve problems related to qualifying and engineer it would be enough to make curricular reforms without concerns, but with crucial questions previously seen, as stressed by Amorim et al. [3]: what is necessary

to solve the new problems that come up with science and technics advance? What is necessary to change the attitude of university teachers and create new pedagogical relationships?

Of the 91 papers published and related to Method and Didactics for the teaching of Engineering, many of them are characterized by the concern in improving the quality of performance of the engineer-professor in the classroom by employing computing tools (Santos, [4]; Mello et al., [5]). Others are characterized by the use of different interaction techniques in the classroom (Cremasco and Cremasco, [6]; Corrêa and Pacheco, [7]). And others still point to the need to alter disciplines for better following the demands coming from the evolution of the technological process (Giraffa, [8]; Pereira and Bazzo, [9]). Nevertheless, one can observe a still reduced number of papers in which the central concerns are around aspects related to the conception that engineer-professors have about the teaching process and teaching planning (Pereira and Bazzo, [9]; Amorim and Pereira, [3]).

There is a great number of papers, mainly from 1995, which point to problems in the formation of the engineer-professor and discuss directions and perspectives for changes in their way of acting (Neto, [10]; Teles, [11]; and Giacheti, [12]). Other papers show the importance of improving the university teacher's performance in the classroom, increasing students motivation by employing different didactic resources (Salgueira and Mesquita, [13]; Miranda, [14]). Even if encouraging, this increase in the number of papers concerned with the aspects related to the guidelines for the formation of engineer-professors, it is still necessary to find out the required behavior to walk towards the pointed direction. It must be clear in what the teaching behavior of the university teacher must consist and the basis from which it is possible to identify this professional's multiple possibilities of performance before those reality aspects which are his/her competence as performance aims. In this sense, "discovering and proposing this behavior by the means of the teaching system seems to be a feasible and promising way to get to a more accurate definition of the historical agents and forms of performance susceptible to leading to the desired change" (Oliveira and Dominice, p. 136, [15]; Botomé, [16]).

Producing knowledge about innovations in teaching is not only a necessity, it is imposed by the historical educational moment. It is necessary to act in relation to what is done in the current teaching. And, in this sense, Lorenzato and Rabelo, [17]; Belhot, [18]; Landares, [19] and Neto, [10] emphasize the importance of improving the university teacher's performance in teaching situations.

The formation of the engineer-professor, just as of other professional-professors, depends on his/her knowledge on quality of different domains and types. Their activities require establishing interdependent

relations of a reasonable amount of conceptions to be examined, explained or modified. How and where to begin the necessary modification to obtain better qualified university teachers and more competent professionals?

1.1 Responsibilities and competences of a university teacher

An urgent task for university teachers seems to be redefining their objectives, modifying values and concepts and making necessary changes. A significant improvement in the educational practice can only be obtained through systematically improving the individual university teacher. According to Lima, "it is for the university teacher the responsibility of not only selecting resources, but also often planning them, and it does not mean a simple selection of equipment or materials" ([20], p. 66). Authors such as Rebelatto et al. [21] and Botomé [16] understand that the merely verbalistic sense of teaching tends to change the more it is understood that teaching plans are actually one of the main channels through which "education" transits. Through it, it is possible, besides understanding the scientific process, to also develop the capacity of thinking about society questions in a logical and critical way. It is characterized as an instrument by means of which its formation and qualification of the university teacher takes place.

"In graduation level teaching (or higher education), access to knowledge has more complex and socially more comprehensive characteristics. In this teaching stage (or type) usually the aim is to enable students to: 1) work with the most advanced knowledge and technology available, 2) derive from recent research and knowledge new forms of professional and personal conduct, 3) integrate data and information from different areas, forms and types of knowledge, 4) constantly analyze and evaluate (criticize) society and their participation in it, 5) work professionally in those levels which are mainly concerned with improving or maintaining good conditions of life, or preventing (controlling determinant variables) bad conditions of life rather than working in remedy procedures (curative, in the case of health work fields), compensating or attenuating in relation to problems, difficulties or sufferings of people in the society where they act" (Botomé, p.126 [22]).

It is possible to detail the list of characteristics of what consists effective university teaching. The five categories developed by Botomé [22] also indicate that university teaching must enable the person to act so as to multiply social benefits through the use of knowledge in his/her actions in the long term and of large social range (planning, administration, coordination, guidelines, considering abstract and comprehensive criteria, orientating local and immediate actions, etc.).

According to Paulo Freire [23], the task of a teacher and in a broader sense of the educator is to present the learner with the contents as if they were

problems, and not to discourse about them, to understand them and hand them in as if they were something already done, elaborated, finished. The teacher's task consists of changing the student's behavior. Some kinds of behavior that the teacher wishes to change occur in the classroom, but others take place outside it. Important changes occur a long time after the student separated from the teacher. The student's performance is directly related to the performance of the teacher, to the objectives adequately chosen for each discipline, to the selection of appropriate situations, so that the educational objectives are attained by means of a strategy that can be applied to the universe of the students with whom one works. Thus it is more favorable to make students interested in each discipline, showing their performance, which will probably bring them sense and self-fulfillment.

How to define the teaching objectives, goals and programs without the knowledge about important aspects of the reality which involves student, teacher and society, without investigating the possible situations with which the future professional will have to deal with? In this sense, it turns out difficult to establish the teaching basis. But which abilities must have the future educator? Which behavior must he/she have for his/her function? In what consists precisely this behavior? And, above all, what should be the outcome of his/her exercise, the production of which objective? In what consists being an educator? It is said that teaching means shaping individuals; but what does this mean? And finally what is the objective to be attained by this craft?

Looking into the scientific production of some authors as for the definition and characteristics of teaching objectives they almost always stress the requirement that the objectives must express student's kinds of behavior in a clear way and supported by the kinds of behavior "outside the school" (Mager, [24]) or "for what is expected of the student after the teaching process" or "contributing for the global purpose of education namely helping the individual to effectively act in everyday life" (Vargas, [25]). However, what is really found in educational institutions is a deficient schooling, in which prevail information, memorization, lack of commitment with teaching those kinds of behavior required outside the school. Botomé [16] exposes the problem and the perils arising out of the common use of information as a starting point for teaching planning. The information available or known generally leads the teacher to neglect the needs his/her students, future professionals, will work for. Thus, they are at the risk of shaping "good intellectuals", but professionals unable to transform the reality in which and for which they will work. The question about the relevance of the objectives seems to be one of the variables which interfere in the kinds of teaching behavior of the teachers. Learning opportunities can be foreseen if the engineer-professor is able to characterize a sequence of human actions when planning and actually teaching.

The same author suggests ten steps of reasoning and behavior to characterize a sequence of actions on the part of the university teacher when planning and teaching: 1) with what kind of situation will the learner deal with when graduated?, 2) what should be the outcome of his/her performances when ... ?, 3) what will he/she be able to do in order to deal with ... and produce ... ?, 4) what does he/she need to learn in order to do ... ?, 5) which resources and repertoire already exist?, 6) in which sequences and parts is it appropriate to divide and organize a set of things?, 7) which instruments, resources, environment and procedures are necessary to ... ?, 8) teaching performance ... , 9) graduated professional, 10) evaluation of teaching efficiency.

The "starting point" to define "what to teach" in this case is not the existing and known information (in general in the books the teacher has access to), but the "needs of the community" where the graduated professional will be put into. Information in the books (contents) is a means to teach what is relevant for the life of the community where this person to be formed is going to act and for the action of this person in the community. Information, "contents", presented and given priority in the conception of "traditional teaching" are not "ends in themselves". As they are "means", they cannot be "themselves" the starting point for teaching.

When it is clear for the teacher what he/she wants his/her students to be able to do, he/she can select more easily the real situations which will direct his/her choosing the activities planned for the teaching. Specifying the objectives emphasizes the most relevant activities.

The concept of teaching planning proposed by Botomé [16] is inserted in a more comprehensive proposal of building up teaching programs or curricula. Teaching must be planned from the specification of what one wants to obtain and with which one will have to deal (reality that the person will be in touch with) in order to obtain the results one is interested in. With these two pieces of information only (the resulting situation and the situation from which one starts) it is possible to say what work (human actions) will be necessary for producing this result from the concrete aspects of reality with which the person will have to deal with. In this sense, the same author alerts for the fact that complex kinds of behavior require as prerequisites simpler forms of learning. Its consequence is that for the referred author the function of teaching derives from the description of the necessary conditions for learning to take place. These conditions must be built up step by step, stage by stage. Teaching is a human activity and therefore subject to behavioral analysis. Teaching is defined by obtaining learning from the student and not by the intention (or objective) of the teacher. In fact the relationship between what the teacher does and the actual learning by the student is called teaching. The problem situation for the teacher is a relationship between what the student does and the reality in which he/she does it. The engineer-professor must be

apt to plan his teaching from the "needs of the professional field". In this sense, teaching plans inform the needs to be developed by these professionals in order to solve or contribute for the solution of these needs, and this implies projecting what must be the professional future.

This study intends to contribute for the process of making explicit a few variables which interfere in the teacher's kinds of teaching behavior by emphasizing as a permanent concern the necessity for educators to put the events that are most relevant for the learner and for the community increasingly under control and give less importance to what he/she himself/herself knows or wishes to inform.

This paper presents aspects related to teaching objectives and part of the data analyzed concerning kinds of professional behavior of engineer-professors involved in university teaching and learning processes developed by Booth [26].

The subjects were 17 engineer-professors from two Departments of the University of Caxias do Sul. Data about the teaching behavior of university teachers was obtained by means of interviews with 30 "open" questions.

In order to organize information for each question of the interview a categorization has been done. These categorizations of each question were organized according to the similarity of verbalizations for the elaboration of the tables. When there was only one type of verbalization, it was transcribed. A criterion considered for making the tables was that of stressing information related to the characterization of the repertoire of the teacher as to the necessary skills for dealing with higher education. Most of the subjects (55,26%) plan the objectives by reducing them to sequences of information starting from a list named minimum contents which is already established and more or less normalized in the Institution. Following this information list one finds the objectives, almost always related to the information topic itself or information set to be "transmitted" to the students, as well as a series of procedures, activities and forms of evaluating the learning process. This reveals how fragile the educational process is in relation to its significance for the society. Such a form of planning does not take into consideration what the student will be able to do when leaving school according to the teaching that took place and the learning that was enabled through it.

2. UNIVERSITY TEACHER'S BEHAVIOR RELATED TO TEACHING OBJECTIVES

Can it be that making explicit the conceptions that university teachers and administrators involved in teaching and research institutions have about teaching help produce changes in the practice of the professional -

when necessary - and the review and constant monitoring of the quality of his/her services? Considering that conceptions about teaching steer the performance of university teachers in their professional practice it turns evident the importance of making such practice explicit in order to make possible, to facilitate or to develop new and different conceptions that allow establishing new relationships and behavior changes compatible with their responsibility and competence.

2.1 Teaching "theoretical basis" as the objective of the discipline

Table A presents a distribution of occurrences and percentages of information from the subjects about what the objectives of the discipline they teach in graduation courses at the University are. The Table records 38 verbalizations presented in 17 items organized in two categories.

Buschell [27] denounces as absurd and makes explicit that it is this kind of thinking that makes teachers say "I taught, it was the student who did not learn." Possibly "obeying the syllabus" is an inadequate path. At least one can ask: what is a "syllabus"? And what does "obey" mean? In general (see items 1 to 6), "obey" means that the teacher has presented or talked about a certain list of topics that he/she intended to "obey" before he/she started teaching that discipline. Or that he/she decided to do in the course of it. In either case, both "obey" and "syllabus" in this path of thought seem to be already outdated ways to plan teaching. The situations of reality in which the students will have to behave after graduating must be clear for the teacher, so that he/she can act coherently according to the needs of the society.

Psychology, when studying human behavior involved with teaching, has already produced much knowledge which is useful to fundament more secure decisions both about what the types of most relevant human behavior to constitute teaching planning are and some important principles to develop teaching of such human behaviors to which the subjects must have access to.

Items 7 to 14 and 15 make "statements of intentions" of the teachers evident such as: to show the students, to enable students, to develop in the students the capacity of learning, to teach the students how to make his/her best to solve problems. One can observe that these are the "wishes" of the teacher and do not clarify what the students will learn with them. This data shows that the subjects do not know the "function of teaching objectives" and do not know how to foresee the necessary conditions for learning to occur.

Items 13, 16 and 17 present "teaching objectives" under the form of performances of the learner: "to foresee structures' properties", "to program a machine", "to optimize" industrial processes". These are better ways to make explicit what one intends with teaching. However, this way is not sufficient yet to explain adequately what is necessary to develop with teaching or at least the teaching goal for each teacher.

The main problem with this way of presenting objectives according to Botomé [16] is to make only the performances explicit without their respective context. According to the author, a more adequate description of the learners' performances should make explicit at least two more aspects besides "what the learner must be able

to do." One of them is: "the situations in which the learner will have to present these performances which are proposed as teaching objectives." Another is "the results he/she should obtain through them." The results show that the subjects are not sufficiently aware of the meaning and function of teaching objectives.

Table A. Distribution of occurrences and percentages of information from the subjects about what the objectives of the disciplines they teach are.

CATEGORIES	SUBJECTS' INFORMATION	OCCURRENCE	%
University teachers' themes or classes of information and intentions	1. Teaching students the theoretical basis, the concepts of the discipline.	12	31,58
	2. Giving students an overview about the contents of the discipline.	1	2,63
	3. Developing the "contents" - obeying the syllabus.	2	5,26
	4. Transferring knowledge to students.	1	2,63
	5. Developing theoretically and practically the fundamentals of the discipline.	2	5,26
	6. Familiarizing students with the techniques, calculations and equipment involved in the discipline.	3	7,89
Possible objectives	7. Showing tendencies of the discipline.	1	2,63
	8. Making the engineer acquainted with the idea that he/she can also be an administrator.	1	2,63
	9. Showing students factors that influence them in their work and decisions.	2	5,26
	10. Enabling students to solve engineering problems.	5	13,16
	11. Developing in the student the capacity of creating and learning.	2	5,26
	12. Developing conditions, skills to handle, deal with and dispose of solid waste.	1	2,63
	13. Foreseeing structures' properties.	1	2,63
	14. Integrating knowledge.	1	2,63
	15. Teaching the student how to make his/her best out of problems.	1	2,63
	16. Programming a machine (CNC).	1	2,63
	17. Optimizing industrial processes.		
TOTAL		38	100,00

It is important for the subjects to have a clear idea of what a teaching objective is and what kinds of objective there are. Botomé [16] makes these two concepts explicit. Teaching objectives are closer to being "those behaviors" that the learner must be able to present when he concludes a given discipline and under the circumstances in which he/she exerts activity for which that teaching intended to prepare him/her. In his work, the author considers that it is necessary to understand behavior not only as what the organism does, but as the "relationship between what the organism does and the environment in which it does." General terminal objectives are elaborated in form of performances that the learner must be able to present after finishing a discipline within the environment where he/she will exert his/her activities, in a level of language generality that allows for specifications without losing characteristics typical of the concept of "teaching objective." Terminal objectives would be the product of this specification, whereas "intermediate objectives" would refer to the performance related to that learning that is necessary to become able for such final performances ("the terminal objectives"). It seems that "performance descriptions" may serve to increase clarity about what each of these concepts are and their usefulness for teaching planning.

Changes in a university require for the university teachers who work there to redefine teaching objectives, their values, concepts and the fact that they can turn these elaborations into behavior as such. The significant improvement of educational practice can only take place when there is good quality knowledge available and accessible convenient questioning relevant aspects related to the central phenomenon of the educational practice: the teaching process.

"Contents" items, information that the teacher wishes to present the students are not the ends or results one wishes or needs to attain through teaching. Already produced knowledge, information or "contents" are means or instruments to help the student to be able to do something with these "contents" or starting from them. The subjects do not know what teaching objectives really mean; they never refer to what the student must do.

What must teachers understand and develop to overcome teaching procedures based on memorizing information on the side of the students? Items 1 - 12 show that understanding teaching objectives is reduced to informing contents items and describing performances from the teacher. In this sense, the data indicates that teaching objectives are considered as synonyms of "teaching contents" and of the intentions or performances of the teachers. The data points to the necessity of enabling teachers to understand teaching objectives.

Botomé [16] expresses the problem and the consequent perils of the common use of "contents" as starting point for teaching planning. The "content" available and/or known usually leads the teacher to neglect the necessities of the community for which students - future professionals - will work. Thus, they are

at the risk of forming "good intellectuals", but people unable to transform the reality in which and for which they will work. The description of objectives centered on the student represents a great advance in proposing teaching objectives while a radical change in its emphasis takes place.

The author stresses also that for the description of a behavioral objective it is not enough to describe the classes of responses involved in a teaching syllabus, because a list of *classes of responses*, be it the longest or the most detailed or specified, does not describe the *behavior* to be installed in the learner since it says nothing respective to the *relations* between the responses of the organism and the environment, which consist of the real aspect that defines any behavior. For the referred author, each class of responses can - and maybe must - *start* a behavioral description so that it becomes a useful instrument in the construction of a teaching syllabus. However, the description of the objective cannot stop in the description of classes of responses. It is also necessary to indicate which classes of stimuli (aspects of environment) relate to the class of responses in focus and that are called "*classes of preceding stimuli*." Such classes of stimuli vary in their generality according to the class of responses that is at stake. It is the *kind of relation* in question that will say "what" and "how much" should be described as "class of preceding and consequent stimuli."

With the results in Table A it is possible to affirm that the subjects understand that the teaching objectives of the discipline they teach are to inform "contents." Classroom activities are centralized on information. It seems that teaching as it has been conducted focuses on the product of knowledge and the performances of the teacher. Thus, the students manipulate symbols, learns by heart, solves the exercises but it seems that he/she did not have the conditions to elaborate the meaning of this information. In other words, the teacher did not help him/her construct the concept of these fundamentals. Judging by these results, it seems evident that the subjects need to "seek" for new points of reference in their pedagogical practices in order to show a teaching behavior for the university.

3. CONSEQUENCES OF KNOWLEDGE ABOUT THE TEACHING BEHAVIOR OF UNIVERSITY TEACHERS AND ITS RELATIONSHIP WITH THE DEVELOPMENT OF THE CURRICULAR STRUCTURE.

How much knowledge will be enough to explain the complexity of phenomena observed in real professional performance in the University's daily routine and in the classroom?

The knowledge produced about the educational process presents other aspects for teaching planning: to

stimulate and contribute by offering procedures of analysis so that university teachers of the same area or of different areas include in their work with teaching other aspects besides the existing "content". Another aspect is to stimulate professionals involved in elaborating or restructuring curricula to take into account as their starting point the needs of society. Based on these studies it becomes possible to make decisions about what the professional must be able to do and what is necessary to teach in order to qualify students, that is, what the teaching objectives are. Only then decisions about the content, the nature of activities to be developed will be made, thus elaborating a proposal with a greater probability to be efficient in relation to technical, scientific, economical, political and social problems.

In order to advance towards a teaching process that qualifies the student to deal with future society requirements it is here suggested: a) a review of the curriculum organization seeking the fulfillment of the teaching and learning process directed to a valuable performance in the community; b) a review of the current didactic-pedagogical model that (separates)"teaching" from the professional's field of action. The results indicate that the current teaching behavior of engineer-professors is related to the lack of knowledge about modes of acting of the teacher for the creation of adequate conditions to students' learning. Which behaviors must the engineer-professor have to create adequate conditions for learning?

3.1 Consequences of knowledge about the teaching behavior of university teachers and its relationship with the responsibilities and competences of the University.

It seems fundamental for the University to clearly define: 1) what it needs to teach in order to qualify people to work and make necessary modifications and 2) how to develop this learning that it defined as important for the student to deal with reality, that is, shortly: in what to invest to try to solve the everyday problems of the engineer-professor? By examining the results presented one sees the need to elaborate an "instrument of support" for the teachers to overcome at least part of the problems existing in teaching in this field of professional performance. Some questions around what is observed in these results can be raised: a) how and what to teach future engineers so that they become apt to make efficient decisions, taking into account the multiple variables of reality and in view of benefits for society?

The leadership of the reformulation process of the current engineering school before the educational challenge imposed by the new Engineering paradigm requires university teachers prepared for a new docent practice, with pedagogical and didactic procedures adequate for the development of the educational process by means of participation and critical thinking about reality (Freire, [23]). The data presented will probably

favor possibilities to increase university teacher's critical thinking and will also favor the obtainment of more explanations which will provide modifications in the current standards of teaching behavior of engineer-professors. University teaching is one of the means to make knowledge accessible. This process allows the transformation of knowledge into behavior. Nevertheless, this transformation is not done in a discursive way. It is not possible to do it through traditional conceptions of what teaching is. It requires more than discourses and adhesions to it. It needs some consistent work with the nature of both phenomena which interrelate and integrate: knowledge and behavior. Two complex processes of relationship with the facts that require competence and deepness enough both in relation to knowing and to teaching, being these the fundamental roles of the University. Integrating them demands from the university teachers that they are able to perform both processes in a high level of efficiency or, otherwise, it may remain in the perspective of a "verbalistic" school on the edge of concrete problems with which its students are faced and not committed with the necessary transformations in society.

How to redimension the educational process and the pedagogical practice in terms of conceptual change in the threshold of the third millennium? How to do it? How to plan the conditions and the teaching today to meet future necessities?

It should be reminded here the responsibility and competence that higher education institutions have to solve these questions. They must take into account the knowledge existing about what means "to behave in an institution and of what is related to this behavior" (Botomé, [22]). They must be aware of their end-activities and from there define their characteristics otherwise any change in university teachers' procedures will hardly go any farther. The consequences will always be about students' learning and the social contribution of the teaching institution by means of the conduct of its students in the environment where they live.

REFERENCES

- 1) LONGO, O. C. Mudança Curricular na Escola de Engenharia da UFF. **XXII Congresso Brasileiro de Ensino de Engenharia (Cobenge-94)**, Porto Alegre, Associação Brasileira de Ensino de Engenharia, 1994, p.94-98.
- 2) CORDEIRO, J.S. e GIORGETTI, M.F. Resolução 48/76 do CFE: ultrapassada ou mal utilizada? **Anais do XXII Congresso Brasileiro de Ensino de Engenharia**. Porto Alegre, RS, 1994, p. 220-226.
- 3) AMORIN, F.A.S. E PEREIRA FILHO, O. Reforma Curricular e Metodologia de Ensino. **Anais do XXII Congresso Brasileiro de Ensino**

- de Engenharia.** Porto Alegre RS, Associação Brasileira de Ensino de Engenharia 1994, p. 426-432.
- 4) SANTOS, M.R. Avaliação de Segurança de Funcionamento em Sistemas – Um Ambiente Computacional. **Anais do XXII Congresso Brasileiro de Ensino de Engenharia.** Recife, Associação Brasileira de Ensino de Engenharia, Vol. (1). 1995, p. 315-324.
 - 5) MELO, M. L. e col. Proposta de um aplicativo educacional para processamento digital de sinais: transformadas rápidas, convoluções e filtros digitais. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia,** Recife, Associação Brasileira de Ensino de Engenharia, Vol. (1). 1995, p. 357-366.
 - 6) CREMASCO, M. A. e CREMASCO, S. B. R. Metodologia de ensino em laboratório de engenharia: emprego da técnica “brainstorming”. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia,** Recife, 1995.
 - 7) CORRÊA, C. J. e PACHECO, M. C. M. N. O processo de delegação responsável aplicada ao ensino da engenharia. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia,** Recife, Associação Brasileira de Ensino de Engenharia, Vol. (1) 1995.
 - 8) GIRAFFA, L. M. M. **O ensino de engenharia informatizado x formação docente.** **Anais do XXII Congresso Brasileiro de Ensino de Engenharia.** Porto Alegre RS, Associação Brasileira de Ensino de Engenharia, 1994, p. 412-417.
 - 9) PEREIRA, L. T. V. e BAZZO, W. A. Estratégia para um ensino de qualidade. **Anais do XXII Congresso Brasileiro de Ensino de Engenharia.** Porto Alegre RS, Associação Brasileira de Ensino de Engenharia, 1994, p. 453-457.
 - 10) NETO, P. S. Interação entre Educação em Engenharia e os sistemas produtivos. **Anais do XXII Congresso Brasileiro de Ensino de Engenharia.** V.2 Recife, Associação Brasileira de Ensino de Engenharia, 1995.
 - 11) TELES, A. R. T. F. Metodologia aplicada no ensino das disciplinas do departamento de transportes da Escola Politécnica da UFBA. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia,** Recife, Vol. (1). 1995, p. 467-470.
 - 12) GIACHETTI, H L. Críticas à metodologia tradicional de ensino de mecânica dos solos e algumas sugestões para mudanças. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia,** Recife, Associação Brasileira de Ensino de Engenharia, vol 1, 1995, p 471-480.
 - 13) SALGUEIRO, A. A. e MESQUITA, N. G. M. Reflexões no processo ensino - aprendizagem em disciplinas Profissionalizantes de engenharia. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia,** Recife, Associação Brasileira de Ensino de Engenharia, Vol. (1). 1995, p. 381-390.
 - 14) MIRANDA, R. J. P. C. O uso do laboratório e computador no processo de ensino e aprendizado de resistência dos materiais. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia,** Recife, Associação Brasileira de Ensino de Engenharia, Vol. (1). 1995, p 487-496.
 - 15) OLIVEIRA, R. D. DOMINICE, P. O debate pedagógico. Em Z. Brandão (Org.) **Democratização do ensino: meta ou mito?** Rio de Janeiro: Francisco Alves, 1979, p.136.
 - 16) OLIVEIRA, R. D. DOMINICE, P. O debate pedagógico. Em Z. Brandão (Org.) **Democratização do ensino: meta ou mito?** Rio de Janeiro: Francisco Alves, 1979, p.136.
 - 17) LORENZATO, S. A. e RABELO, E. H. **Ensino da Matemática: reflexões para uma aprendizagem significativa.** Campinas. Ano 2. N.2, março de 1994.
 - 18) BELHOT, R. V. A informática no ensino. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia.** V.1. Recife, Associação Brasileira de Ensino de Engenharia, 1995.
 - 19) LANDARES, J. B. A reengenharia do ensino de Engenharia. **Anais do XXIII Congresso Brasileiro de Ensino de Engenharia.** V.1. Recife, Associação Brasileira de Ensino de Engenharia, 1995.
 - 20) LIMA, J. A. S. e VAZ JR., M. O método de volumes finitos: uma proposta de ensino na graduação. **Anais do XXII Congresso Brasileiro de Ensino de Engenharia,** Porto Alegre RS, Associação Brasileira de Ensino de Engenharia, 1994, p.396-401.
 - 21) REBELATTO, J. R. e BOTOMÉ, S. P. **Fisioterapia no Brasil: perspectiva de evolução como campo profissional e como área de conhecimento.** São Paulo: Manole, 1987.
 - 22) BOTOMÉ, S. P. **Pesquisa alienada e ensino alienante: o equívoco da extensão universitária.** Petrópolis, RJ: Editora Vozes; São Carlos, SP: Editora da Universidade Federal de São Carlos; Caxias do Sul, RS: Editora da Universidade de Caxias do Sul, 1996, p. 126.
 - 23) FREIRE, P. **Extensão ou Comunicação?** Rio de Janeiro: Editora Paz e Terra, 1971.
 - 24) MAGER, R. F. **A formulação do objetivos de ensino.** Porto Alegre: Ed. Globo, 1976.

- 25) VARGAS, J. S. **Como formular objetivos comportamentais úteis.** São Paulo: Ed. Pedagógica e Universitária, 1974.
- 26) BOOTH, I. A. S. **Ensino de Engenharia: Comportamentos Profissionais de Engenheiros – Professores em Relação aos Processos de Ensinar e de Aprender em Nível Superior.** Universidade de Caxias do Sul, 1996 (Tese de Mestrado apresentada ao programa de Pós-Graduação em Educação da UFSCar).
- 27) BUSHELL, D. **Classroom behavior: a little book for teachers.** New Jersey: Prentice-Hall Inc. 1968.