DIAGNOSIS OF TEACHING CONCEPTIONS OF ENGINEERING FACULTY AT THE UNIVERSIDADE DE CAXIAS DO SUL

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Abstract
In order to diagnose the teaching conceptions of engineering faculty at the Universidade de Caxias do Sul, 17 engineering faculty were interviewed. The results indicate serious deficiencies in the scientific and pedagogical formation of the engineering faculty with regard to the aspects examined. The data collected allowed us to propose specific actions to compensate these deficiencies and to minimize the influence of the variables that determine them. They are already being used in the teaching qualification program at our university in order to help engineering faculty to innovate and improve their classes. Finally, this kind of data can also help in elaborating proposals to build undergraduate programs in engineering education in Brazil.

Workshop Topics
Human scale engineering; Beyond active learning.

I INTRODUCTION

We all agree that students are central to the educational process. As such, they should be active participants in the educational transformation process. In this context, we could ask: “What does it take for the educational experience to develop the motivation, capability, and knowledge base for lifelong learning?” The student being "active" during the educational process could be the answer and we all know that this is completely necessary but not a sufficient condition. So, where else should we place the emphasis?

Many engineering educators around the world are concerned that the learning experience must move from the lecture as the dominant mode to include a significant level of active learning approaches [1-4]. These approaches should encourage world class design, development and implementation processes for engineering systems. They also believe that cooperative learning approaches and other contextual learning experiences must be integrated within the classroom. Some

engineering educators believe that we must encourage faculty to assume a more active role not only in the implementation/delivery of the educational experience for the student, but also in the innovation and continuous improvement necessary for engineering education to meet the challenges. But how can people in charge of an engineering program know whether the faculty is providing their students with an educational experience to develop the motivation, capability, and knowledge base for lifelong learning?

At the Universidade de Caxias do Sul, the administration is concerned about the teaching conceptions of our engineering faculty. A project has been developed in relation to this subject and will be reported here.

To diagnosis teaching conceptions of the engineering faculty when acting in engineering education involves answering some questions: (a) which are the variables that underlie the faculty teaching conceptions? (b) What are the attributes of these variables? The elaboration of studies to answer these questions is important for the engineering faculty to overcome some existing problems in teaching in this field. The identification of some of the variables that interfere with the engineering faculty's teaching conceptions can point out gaps that need to be corrected [5].

The production of knowledge on this subject can help these professionals to question their ways of acting, to review concepts and to develop new conceptions in professional practice, extending their performance possibilities. The new discoveries probably will help to create more adequate conditions so that the engineering faculty can develop new teaching strategies for the university environment, making possible the formation of up-to-date and competent professionals that are committed to ethical values and to society's needs.

In order to diagnosis the teaching conceptions of engineering faculty at the Universidade de Caxias do Sul, 17 engineering faculty were interviewed. The data collected through the interviews and the analysis of these data are presented and discussed at this paper.

II IDENTIFYING THE PROBLEM

The engineer's performance as university faculty is a question which has not been explored that much in Brazil. To know what constitutes this performance and to determine which variables intervene with it, it is necessary to study the education situations that constitute the reality with which the faculty member deals. The development of the student's learning still depends a lot on the faculty member´s behavior [6].

Therefore it becomes necessary to investigate the characteristics of this performance, that is, what defines the research problem. The characterization of professional practice of engineering faculty in the teaching process is an important

condition for taking action in engineering education. Teaching is considered by diverse authors as the process that develops abilities [7-9]. The development of abilities is directly related with the understanding of the teaching and learning processes. It involves complex abilities which are practically inexistent in the educational environment, as well as a type of knowledge not yet familiar to most faculty and students.

In the undergraduate programs, the abilities to be developed need to be related, amongst other aspects, to: learning how to learn; systemizing the scientific knowledge, deducing from the research results, new possibilities for resolution of problems; constantly analyzing and evaluating the society and his own participation in it; acting in a systemic way, integrating himself in a complex relational system; presenting behaviors that characterize a psychological, emotional, political, ethical and scientifically mature person; to perceive events and phenomena in a systemic way, in the sense of more inclusive, articulated, linked.

In this sense, the efficient teacher is that one that, independently of the fact of working with chalk and blackboard, or technological resources, creates strategies that are able to develop abilities and competencies in the students so that they can intervene significantly with the situations with which they deal, promoting socially relevant results [10].

With the purpose of investigating the teaching conceptions of engineering faculty at the Universidade de Caxias do Sul, seventeen faculty members from two engineering programs were interviewed.

III METHODOLOGY

The sample studied in this work consisted of seventeen faculty members from two engineering programs at the Universidade de Caxias do Sul. All the faculty from the chemical and mechanical engineering programs, totaling 42 persons, were contacted, but only 17 accepted to participate.

III.1. Establishing Contact and Formal Invitation

The first contact was established via e-mail, inviting these faculty members to participate in this research. For those who responded to this first contact and agreed to participate, a second contact was established via phone in order to determine the time and place where the interview would be held. The two possibilities were the office of the faculty member being interviewed or the office of the interviewers. The person to be interviewed was allowed to choose the place. A formal invitation was sent by the interviewers to the faculty members to be interviewed via internal regular mail of the university.

III.2 Instruments of observation and registration

Two questions were asked: (i) what do you understand by “teaching” in engineering education? And (ii) what do you take into account when you are preparing your classes?

The answers were registered in a computer. None of the faculty members being interviewed allowed the use of sound recording. No time limit was imposed for ending the discussion, although none of the interviews lasted more than 15 to 20 minutes.

III.3 Analysis of the material registered

Content analysis was used to analyze the recorded transcripts of interviews. According to Krippendorff [11], six questions must be addressed in every content analysis: (i) which data are analyzed? (ii) How are they defined? (iii) What is the population from which they are drawn? (iv) What is the context relative to which the data are analyzed? (v) What are the boundaries of the analysis? (vi) What is the target of the inferences?

The assumption is that words and phrases mentioned most often are those reflecting important concerns in every communication. Therefore, quantitative content analysis starts with word frequencies, space measurements, time counts and keyword frequencies.

IV RESULTS: CARACTERIZING THE CONCEPTIONS

The 17 engineering faculty interviewed categories generated 33 verbal statements expressing their conceptions about teaching. The 33 verbal statements were organized in 4 categories as presented in Table 1. In this paper results are presented only for the question “What do you understand by “teaching” in engineering education?”

From the analysis of the data in Table 1, it can be observed is that there is an emphasis on and a valorization of the syllabus topics, theoretical or technological, in detriment of other aspects related to the undergraduate education that, in turn, have a direct consequence on faculty practice and, consequently, on the quality of the formation offered to the future engineers.

The interviewed faculty members affirm that teaching is to transmit the subject matter of the area. It can be observed in Table 1 that the category “subjects of the course” (60.60%) is the most indicated, where items 1 the 6 prioritize the syllabus topics.

Table 1 - Distribution of responses obtained from the interviewed faculty about "teaching" in engineering education

Categories	Responses obtained from the interviewed faculty	Occurrences	%
Subjects of the course	1. To transmit the subject in a clear and logical way	7	21,21
	2. To create an ordered sequence to present the subjects mentioned in the syllabus of the course	2	6,06
	3. To use demonstrations to illustrate the subject studied	2	6,06
	4. To transfer knowledge	4	12,12
	5. To ask, to remind and to emphasize what was already studied	4	12,12
	6. To show what is old and what is new in the area	1	3,03
To consider and to introduce "new" strategies	7. To take the students to the library and show them how to use it	2	6,03
	8. To give an opportunity to the students to evaluate if they are right or wrong in their assumptions	1	3,03
	9. To help the students to become independent learners	1	3,03
	10. To give examples to help students to learn	1	3,03
	11. To consider societal problems	2	6,06
	12. To solve exercises related to industrial problems	2	6,06
To consider the role of emotions in teaching	13. To increase the perception, sense of security and increase the level of expectations of the students	2	6,06
Others	14. This is all philosophy	1	3,03
	15. This is too complicated	1	3,03
	TOTAL	33	100,00

They also say that to transmit and communicate knowledge already elaborated constitutes the vast majority of the actions involved in "teaching". A great emphasis is placed on completing the syllabus topics for each course: "The neurosis of the syllabus". This is one practice that leads to a lamentable loss of focus of the real meaning of being a teacher and of teaching. In such a way, faculty "deliver" a kind of teaching where:

- knowledge is transmitted formally, technically, totally distant from reality and filled with meaningless concepts;
- faculty actions concentrate on achieving the retention of information by the students, in a passive way, with the intention that this information will be returned;
- assessment is composed of repetitive tests and mechanical exercises, where the students need to express the memorized information in the same terms where they had been presented.

The characteristics shown above correspond to a traditional teaching-learning process that is nothing but the transmission-reception model. In this model the teacher seems to be unaware of his role in helping the students in the construction of procedural and attitudinal knowledge, to say the least.

Another misconception that appeared in the undergraduate teaching practice, from the analysis of the verbalizations, can be observed in items 7 to 12 of Table 1. These items show that teaching consists of (27.27%): ways to show the student how to acquire knowledge, to give opportunities to the student, to help the student to become a self-learner; to give examples, to consider problems of the society, to solve exercises. These verbalizations may show some "good intentions" from faculty, although they do not clarify what they are going to teach. The biggest problem with these teaching conceptions is that the teachers do not say anything (or they say very little) regarding what will have to be generated or produced, concretely, by the actions of the faculty when dealing with their students.

A small fraction of the interviewed faculty (6.06%) consider that teaching is taking into account the role of emotions They say that it is necessary to increase the perception, sense of security and increase the level of expectations of the students.

Finally, another small fraction (6.06%), say that this kind of question is pure philosophy or that this whole business of what is teaching is too complicated.

In this context, and based on the results reported above, one question especially can be posed: how to teach and what to teach to the future engineers so that they become able to make efficient decisions, taking into account the multiple variables of reality, and having permanently in sight benefits for the society?

V CONSTRUCTING ALTERNATIVES FOR INTERVENING IN THE PROBLEM

The results of the research suggest that it would be desirable to change attitudes of the engineering faculty, leading them to: a) build new pedagogical relations with their students; b) learn to think with new epistemological conceptions, in a manner that stimulates the students to face, in critical and creative ways, the problems of their professional universe, including the educational and social areas; c) formulate

policies in the institution that involve the creation of training programs for the engineering faculty, prioritizing the formation of the teacher as well as the researcher; d) build a new pedagogical and epistemological model that contemplates aspects of reality to plan the education directed towards the construction of a set of abilities and competences that need to be developed in this process; e) to take in account the problems, the demands of their professional field and to dialog with the organizations, institutions and companies of the society.

This means that teaching must be carried out in contact with the social reality (the concrete situations which the people confront or will confront). When studying and systemizing knowledge, it is also necessary to know how to deal with reality and how to overcome what happens, using this knowledge; f) be interdisciplinary, to integrate multiple types of knowledge from different areas in the processes of decision making and behavior in the professional field of the future engineer. This also means to value, to understand and to use points of view, techniques, concepts and information of other areas which are not those directly, and more intensely, related with the field where the professional acts. Such training needs, to be useful, to be developed, to be socially inserted and existentially rewarding for the engineering faculty. It must also involve other aspects of the work in society: social responsibility, ethical behavior, social relationship, care with the environment, exercise of citizenship, capacity to plan, capacity to invest (not in the financial sense only), administration of resources and evaluation of the work. It is a formation that conceives the professional not as a restricted being but as somebody that lives, interferes, does research and suffers influences from one definitive environment, of which this professional is part and that is part of him.

It is fundamental to use a strategy that is basic and that can be applied to the students with whom the faculty member is working, trying to help them to become citizens conscious of their performances, which will bring to them, without a doubt, a sense of accomplishment.

VI FINAL REMARKS

Reeducate the teachers concerning their function and the types of abilities to develop seem basic if one intends to undertake a pedagogical practice that facilitates the students' learning process. If different abilities are developed in different forms, one cannot organize a pedagogical routine that disrespects such differentiation. The teaching-learning planning must consider the social and scientific requirements of the current context and its demands as well as to promote a significant learning for the students, articulating factual, procedural, conceptual and attitudinal knowledge in an efficient way abandoning the informative dimension only, in order to reach a truly formative learning environment.

In summary, the results indicate serious deficiencies in the pedagogical formation of the engineering faculty with regard to the aspects examined. The data collected

allowed us to propose specific actions to compensate these deficiencies. They are already being used in the teaching qualification program at our university in order to help engineering faculty to innovate and improve their classes. Data from the question "What do you take into account when you are preparing your classes?" are being analyzed and will be published some time soon. Finally, this kind of data can also help in elaborating proposals to build undergraduate programs in engineering education in Brazil.

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