DOCUMENT RESUME

ED 441 666 SE 063 512

AUTHOR	Kuri, Nidia Pavan
TITLE	Kolb's Learning Cycle: An Alternative Strategy for Engineering Education.
PUB DATE	2000-00-00
NOTE	7p.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Cognitive Style; Conventional Instruction; Creativity; *Engineering Education; Higher Education; *Learning Processes; Teaching Methods; *Technology
IDENTIFIERS	*Kolb (David A)

ABSTRACT

The knowledge of exponential development, the multiple aspects of social problems, the fast technological advancements and the growing availability of advanced hardware and software are increasing demands on undergraduate engineering education and practice. Therefore, it is imperative that engineering teachers become able to accomplish much more than the simple assignment of transmitting information: they have to teach their students "how to learn" so the students will be prepared for any challenges. More effective teaching methods and techniques have to be considered beyond the traditional model, which is based on information transmission and fully centered on teachers' figures. However, this method's implementation fully requires comprehension of the available alternatives and the possibility of creating them by the teacher. This work aims to present David Kolb's ideas about learning styles and describes his empirical model--the Learning Cycle--as an alternative strategy to deal with the widely used traditional way of teaching engineering. The four styles or types of learning identified by Kolb derive from the manner in which people perceive and process new information. Each one these styles is associated with some typical questions that represent the internal structure of learning, which can be seen as a standard model for new concepts of learning and can be used regardless of subject matter. (Contains 10 references.) (Author/ASK)

KOLB'S LEARNING CYCLE: AN ALTERNATIVE STRATEGY FOR ENGINEERING EDUCATION

Nidia Pavan Kuri

School of Engineering of Sao Carlos
University of Sao Paulo
13560-250 Sao Carlos, Sao Paulo, Brazil

Abstract - *The knowledge exponential development, the multiple aspects of social problems, the fast technological advance and the growing availability of advanced hardware and software are increasing demands on undergraduate engineering education and practice. Therefore, it is imperative that engineering teachers become able to accomplish much more than the simply assignment of transmitting informations: they have to teach the students "how to learn"so they might be prepared for any challenges.*

More effective teaching methods and techniques have to be considered beyond the traditional model, which is based on information transmission and fully centered on teacher's figure. However, this methods implementation requires fully comprehension of the available alternatives – and the possibility of create them – by the teacher.

This work aim to present David Kolb's ideas about learning styles and also describee his empyrical model – the Learning Cycle – as an alternative strategy to deal with the largely used traditional way of teaching engineering . The four styles or types of learning identified by Kolb derive from the manner which people perceive and process new informations. Each one these styles are associated with some typical questions that represent the internal structure of learning, which can be seen as a standart model for new concepts learning and can be used regardless of subject matter.

1. Introduction

The practice of the engineering comes moving in an irreversible way, forced by factors as the increase of the competitiveness and consequent industry restructuring, the diffusion of great corporations, the "technological unemployment" provoked by the massive use of new technologies, as well as for the appearance of new fields of performance, as it is the case of the tertiary section. Before these and another factors, it has been discussed the need of professional's formation with profile adapted to the demands of the new labor market, through the creation of new courses and *curricula* in syntony with the current rules of the market.

Today, the success in the engineering demands much more than technical capacity. It requests capacity for effective communication, leadership, performance highlighted in a teamwork, domain of the modern techniques of the engineering, initiative and creativity. Although the traditional teaching of engineering comes executing its role well, it is not unlikely that it could form capable professionals to answer to all challenges of the new world scenery. A new paradigm is necessary and it should affect institutions, teachers and students with the same intensity.

The traditional model of teaching, based on the transmission of knowledge and centered on teacher's figure is the most used in the engineering teaching, but the only application of that model has little survival chances before the explosion of the information technology. Consequently, it is imperative that the educators execute much more and besides the task of transmitting knowledge: it is necessary to teach the students how to learn, so they can be prepared for an entire learning life. It is necessary that they have a solid knowledge of the fundamental principle, a domain of refined strategies for problem solving, capacity to think and to act in an independent way and to work and learn in groups.

Methods and techniques alternatives for teaching and learning need to be considered besides the traditional model, based on the transmission and reception of information and centered in the teacher's illustration. However, the implementação of new methods requests that the educator is aware of the available alternatives or that he is capable to create new ones, disposition to dedicate time and necessary personal effort to perform the changes, beyond, is clear, of an education system that encorages teachers to invest more in the students' learning and in their own development as educators.

This work approaches the theory of Kolb [1] on styles or learning types and it describes the empiric model developed by him - the Cycle of Learning. Conceiving the learning as a cycle of four apprenticeships, the model supplies a good structure for the planning of the learning and, in that sense, it is suggested as an alternative strategy for the development of abordagens complemental instrucionais to the traditional form, broadly used in the engineering teaching.

2. Learning Styles

It is perfectly natural that the teacher thinks of teaching and learning with base in its own experiences and, like this, plan the activities of its students' learning in the same way which he learned or taught with larger success. However, the students learn in several ways: some react positively to the lecturing and they accompany with interest the demonstrations, while others prefer the situations that offer opportunities for they place the "hands on"; some prefer to study alone and others produce more if in interaction with other colleagues; and other, still, react better to the situations that propitiate them time to contemplate or to apply the new knowledge in real situations.

The teachers also come in different ways in class room. They have been used varied techniques and methods: some emphasize the understanding, while other emphasize the application of the material to be learned; some use demonstrations and others prefer to promote discussions; some motivate the individual and other motivate the efficiency in the work groups. Therefore, how the students learn in class room is governed, partly for their own previous prepare and abilities and, partly, for the compatibility between their learning style and the teaching style of the teacher.

So, to teachers and students take the maximum profit of the learning-teaching relationship, it is necessary to recognize their preferences and use all the available resources to guarantee the success. But, what is learning style and which are the styles identified by the educational researchers? Although the existence of individual differences is quite spread and accepted, the educational researchers define styles differently: Gregorc [2] emphasizes different behaviors and dualities as indicators of how the person learns and adapts to the environment; Dunn and Dunn [3], relate incentives and elements (environmental, emotional, sociological and physical) and Schmeck [4] conceives learning styles as a strategy, examining it on the basis of individual actively processing information while involved in the learning task. In agreement with Dunn et al. [5], for Kolb the learning style "is the result of hereditary equipment, past experience, and the demands of the present environment combining to produce individual orientations that give differential emphasis to the four basic learning modes postulated in experiential learning theory: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE)."

In the *Concrete Experience* (CE) or "feeling" the learner enters in contact with new information and you/he/she tries to integrate them to his own values and feelings. He tends to trust more in his feelings than in a systematic method to attack the problems and situations. The personal involvement is emphasized and the learning hapens based on specific experiences, personal relationship and sensibility to the values and personal feelings.

In the *Reflective Observation* (RO) or "watching" the learner examines the ideas of different point of views. He tends to be patient, objective and careful in the judgement, but he doesn't necessarily take any decision.He trusts in hisown thoughts and feelings to form opinions. The learning is characterized by the careful observation and thinking before doing judgements.

In *Abstract Conceptualization* (AC) or "thinking" the learner try, logic and systematically, to organize the information in concepts, theories and principles. He tends to leave its personal opinions sideway and to obtain an universal description or general principle. The logical analysis of the ideas, the systematic planning and the intellectual understanding of the situation characterize the learning in this apprenticeship.

In the *Active Experimentation* (AC) or "doing" the learner wraps up directly with the situation to test the ideas. He tends to apply the material learned in new situations to solve real problems. The world is manipulated and tested to obtain answers. This learner type has ability to do things, to face risks and he can influence the people and events through the action.

The theory of Kolb describes, therefore, the process through which the four systems or modes of human experience are engaged at various levels of complexity to create more complete levels of the understanding. The adaptative engagement between and among CE, RO, AC and AE are constituted in pre-requirement for the learning and personal development. Thus, a person can try to solve a problem analyzing it exclusively under its personal perspective or considering similar problems; while other try to solve it reflecting about it and elaborating a resolution plan or testing several application manners to arrive to the resolution. The base of the theory of Kolb is, therefore, the balance and the experience in all the four learning types. The favorite learning style of any student can be identified using the Inventory of Styles of Learning, developed by Kolb. This inventory is a test of preferences selection that requests identification with the several descriptions of the four learning abilities. With the application of that test in thousands of students, Kolb discovered that the students themselves are declared as belonging to one of the four types, to which he denominated of divergers (Type 1), assimilators (Type 2), convergers (Type 3) and accommodators (Type 4), as demonstrated in Fig. 1.

In agreement with Stice [6], *Divergers* prefers to learn from the concrete experience (CE) and reflective observation (RO). They are creative, efficient to generate alternatives, to identify problems and to understand people. Those that are essentialy of this type can be too much involved with the alternatives, finding difficulties to take decisions. If this feature is no strong, they can have difficulties to generate ideas and recognize problems and opportunities. They try to know the value of what they will learn and their favorite subject is the question "Why? " ("Why is important to know this concept?")

Assimilators learn through the reflective observation (RO) and abstract conceptualization (AC). They work very well with a great variety of information, placing them in logical order. They are generally more interested in the logic of an idea than in its practical value. If they are strongly assimilators, they can build "castles in the air" , becoming unable to apply their knowledge in practical situations. If they are less assimilators, they don't take profit of their own mistakes, lacking their basis and sistematization in the work that they do. The favorite subject of this type is the question "What?" ("What do I need to know to solve this problem?)

Convergers likes to learn through abstract conceptualization (AC) and active experimentation (AE). They appreciate to do practical applications of ideas and theories, they have good acting in the conventional tests, they use the deductive reasoning and they are good to identify and solve problems and to take decisions. If strongly convergent, they can mistake in the solution of problems because of their precipitate decisions. Those that are less convergent can lose central axis of the work, becoming disperse. This type favorite subject is the question "How?" ("How can I solve this problem?")

Accommodators prefers to learn from active experimentation (AE) and concrete experience (CE). They adapt well to immediate circumstances, they learn placing the "hands on" and facing risks. The strongly adapters tend to usetheir energy in any activities, independent of its relevance and priority. The less accommodators don't conclude their works in time, they have impracticable plans, lacking their objectivity. The favorite subject of this type is the question "What if? " ("What if I do something different to solve this problem?)".

According to Felder [7]; the traditional engineering teaching focuses almost exclusively formal presentation of the material (lecturing), a style comfortable just for the Type 2 students. To reach all the types, the teacher needs to expose the relevance of each new study topic (Type 1), to present the basic information and the methods related with the topics (Type 2), to supply opportunities to practice the methods (Type 3) and encourage the exploration of applications (Type 4).

3. The Learning Cycle

The Learning Cycle can be seen as a model for the learning, which intern structure is represented by the subjects: "Why?", "What?", "How?" and "What if?." (Fig. 1). According to Harb et al. [8] in this cycle, the concrete experimentation (*feeling*) it creates a need for the learning, that induces to the reflective observation of the experience (*watching*), that is followed by the introduction of concepts (*thinking*) to integrate the new experience that is already known. After the integration, the action is induced (*doing*) and since this action alters what is already known, new experiences happen and the cycle repeats. To walk through the cycle means, therefore, to answer several subjects in a sequential order.

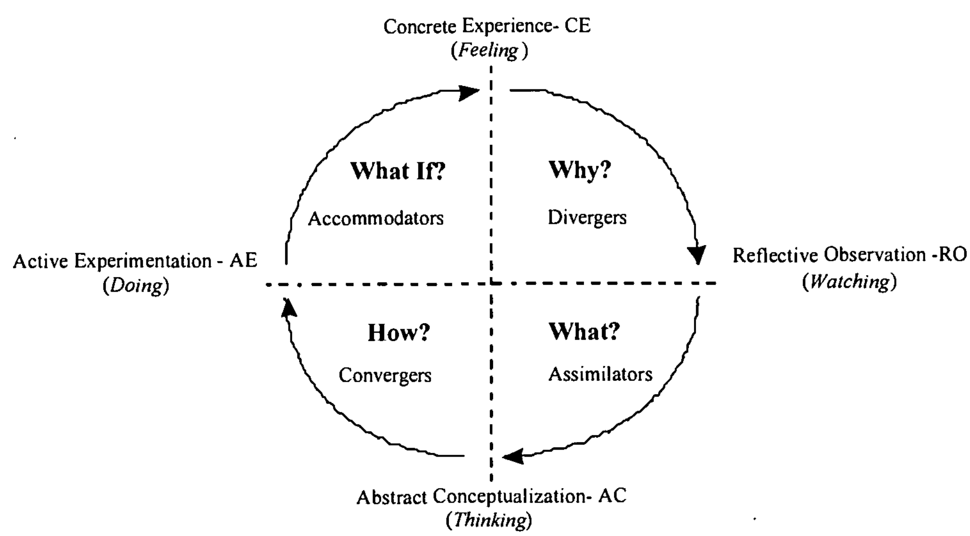

Figure 1 - Learning Cycle

It is important that each student learn how to move through the cycle, that is, how to answer to each one of the four subjects. Some engineering teachers can have the opportunity to learn this while they are working in M.Sc. and Ph.D. degree. The challenge now is to help teachers and students to learn how answer to these subjects. For that it is necessary that they promote varied teaching activities addressed to the different learning styles,in order to improve the movement through the cycle.

The movement through the cycle can be, therefore, gotten through the appropriate interaction enviroment/activities for each one of the four subjects. A lot of options can be intuitively chosen, another are more difficult to be placed. However, the teacher can elaborate a teaching plan so that the students can walk through the cycle. For example, demonstrations, report of experiences, simulations and discussions in class, can be activities drifted for the subject "why?"; formal classes, with emphasis in the reasoning, seminars, resolution of problems by the teacher, for the subject "what?"; resolution of problems for the student (individually or in group), simulation for computer, field work, for the subject "How?"; and, finally, for the subject "What If ?", resolution of open problems, prepared problems for the students and projects.

It is necessary more than the correct choice of the teaching activities to make students move through the cycle. The teachers also need to have conscience that they also have theirs own learning and teaching styles, and that those students who have compatible style can learn easier and quickly than those with different styles. Therefore, another necessary conditions are to select and to develop teaching methods adapted to each one of the cycle phases, because besides assisting to the several types of students, maintaning the interest of everybody with relationship to the discussed subject and facilitating the learning retention, it renews teachers'enthusiasm with relationship to the educational process, because it eliminates a lot of the embarrasment caused by the formal classes.

In agreement with Harb et al. [9], four teaching methods are related to each phase of the cycle. They are respectively:

1) *questioning*, that generates personal involvement and the student's commitment to the immediate objective of the learning, establishing the motivation to learn (Why?); 2) *didactics*, that demands the efficient transfer of the knowledge, requesting the consistent organization of the content and clear presentation of the information (What?); 3) *coaching*, that frequently involves the active experimentation and the work with abstract concepts, helping the students to learn how to work alone (How?) and; 4) *simulating*, that involves the active experimentation and the concrete experience, placing the students in contact with professional world so that they solve real, open and complex problems (What if?).

It's important to point out, however, that this division cannot be considered absolute, because each one of the four methods can be modified and used in anyone of the other three phases of the cycle. The combination of the teaching methods with the learning activities depends a lot on the teacher's creativity, because there are many ways of "teaching through the cycle."

4. Applications in Engineering Education

Numerous reports about the application of the Cycle of Learning in engineering education found in the pertinent literature show clearly that the benefits of its implementation are very significant. Some authors describe how they heve reformulated their disciplines in an effort to reach the whole spectrum of the learning styles; others tell how they have achieved success using a variety of techniques and learning activities, such as probelm-solving in group, projects and exercises in complementation to the formal classes. Many other teachers have involved the Cycle in researches about educational themes, presenting and publishing works related with the engineering teaching. Other, still, developed or are developing questionnaires, inventories or indexes aiming to identify the styles of their students' learning and to improve its engineering teaching, increasing the use of methods gone back to the specific types of students.

The learning cycle can be used as a strategy of engineering teaching, independent of the matter. In that sense, the work of Kuri and Giorgetti [10] offering Courses of Engineering Teaching, aiming to contribute with the training of teachers and future teachers of engineering: how to act, with creativity, in the field of the teaching methodology, it is a good example. Although those courses have begun in 1984, only since 1993, the authors included in programming a detailed study of learning styles theory and the implementation of the learning cycle as a practical task for the participants.

The first contact with the model developed by Kolb is highly motivador and its implementation is a constant challenge, but the results have been worthwhile: the teachers and students potencialize abilities, change experiences and eagerly try to obtain more information on the methods and techniques more adapted for each teaching and learning style, in search of better results in the task of teach and learn. It can be difficult at the first time, but the advantages of its application are very exciting: the great satisfaction of those involved and the support to the four educational goals: development of the reasoning, resolution of problems, communication and solemnity-motivation.

Belhot [11], taking the learning cycle as a reference, suggests four different teaching-learning approaches, that link with each one of the cycle stages. They are: prospective, formative, prescritive and constructive wich concisely, are described as follows.

In the prospective approach the strategy is, considering the context, to justify new experiences so that the student notices which is the object of his study, the relevance of the associated problems and the importance for the current moment of the course and his relationship with the future career. It is on that moment that the student begins its learning experience and to motivate him is teacher's role. For so much, he suggests activities that favor contact with reality and the student's personal involvement, such as technical visits, reports of experiences and cases/problems discussion.

In the formative approach, the strategy is to speculate, placing the student in contact with the beginnings and concepts that will aid in the identification and resolution of problems. The teacher must present the information in an organized and integrated way, to supply models and to open space for activities that favor the reflection and search of student's own facts. The use of the computer is highlighted by the author as source of information and training.

In the prescritive approach, the strategy is to solve problems and situations contextualized and identified in the previous stages. It is the moment of theory and practice integration of the. The teacher must help the students to acquire experience with the taught material, promoting activities that emphasize the application of the concepts and the construction of models. Here, the computer assumes the function of facilitator inthe resolution process, simulating situations that cannot be reproduced in the school atmosphere.

In the constructive approach, the strategy is to test and manipulate the abstractions to obtain practical results or to create something that has personal significance. The resolution of semi-structured and open problems are suggestedhere because of the emphasis relapses in the analysis and evaluation of the consequences and impacts of the lifted up alternatives. Competes to the teacher to stimulate the independent learning, the solemnity-discovery and the creativity. The work in team is also stimulated so that the students can share their own discoveries.

As it can be observed, the use of the cycle increases the students' motivation with learning styles that are not assisted by the lecturing, typically preponderant in the university middle. Developing abilities in the four apprenticeships, the students are moved more quickly through the cycle and this certainly turns them solemnity-motivated, independent and creative.

5. Conclusions

The fast knowledge evolution and the activities diversity are imperative to put in evidence that education in engineering should contemplate the future engineers of a wide and conceptual formation that allows them the fast domain of new technological developments and unembarrassed performance. It is necessary to change the orientation and make it work, always reminding the current moment, in order to identify the opportunities and risks of the current labor market and take actions that adjust to the transformation process or the process of engineer's formation. It is necessary to define what is wanted and then establish which resources are necessary to reach the proposed objective.

It is necessary to qualify the future engineer to adapt to the new reality, creating work opportunities and not just simply exploring the existent, as well as to prepare him to drift with creativity and flexibility and not more to reproduce well-known solutions. It should also be reminded, that the knowledge of the techniques only is not enough, but mainly to interpret, analyze and criticize them to know the why, when and for what they should be applied.

The efficiency in any professional activity also demands a good acting in all the dimensions of the learning styles, and one of the objectives in engineering education should be aiding the students to develop their abilities in the favorite and less favorite learning styles. The model here described supplies that opportunity, because besides helping the students become independent, it stimulates the reasoning, the development of the necessary abilities for the resolution of problems and the communication to each apprenticeship of the cycle. The problem solving promotes the development of analysis abilities, synthesis and evaluation, abilities which are not encouraged by lecturing, but that are clearly necessary in the engineering teaching, because they are indispensable component for the projects development. Finally, the learning cycle supplies a practical and accessible model to teachers that aims the increasing of the engineering teaching and learning.

6. References

(1) KOLB, D. A.(1984) – "Experimental Learning: Experience as the Source of Learning and Development", Prentice-Hall, Englewood Cliffs, N.J.

(2) GREGORC, A. F.(1979) – "Learning/teaching styles: Their nature and effect. In Student Learning Styles: Diagnosing and Precribing Programs". Reston, VA: National Association of Secondary School Principals. p.19-26

(3) DUNN, R. & DUNN, K.J. (1979) –" Learning Styles: Should they, can they, be matched? " , *Educational Leadership*, 36(4), p. 238-244

(4) SCHMECK, R. R. (1982) – "Inventory of learning processes". In *Student learning styles and brain behavior.* Reston, VA: National Association of Secondary Schools Principals. p.73-80

(5) DUNN, R. et al. (1981) – "Learning Style Researches Defines Differences Differently", *Educational Leadership*. p. 372-375. Feb.

(6) STICE, J.E. (1987) – "Using Kolb's Learning Cycle to Improve Student Learning". *Engineering Education.* p. 291-296. Feb.

(7) FELDER, R. (1996) – "Matters of Style", *ASEE PRISM.* p.18-23. Dec.

(8,9) HARB, J.N. et al (n/d) –"Teaching Through the Cycle: Application of Learning Style Theory to Engineering Education at Brigham Young University", 54p. BYU Press.

(10) KURI, N.P. & GIORGETTI, M.F. (1993) – "Estilos de Ensino e Estilos de Aprendizagem". São Carlos. 25p. Apostila - Centro de Tecnologia Educacional para Engenharia, Escola de

Engenharia de São Carlos. Universidade de São Paulo.
(11) BELHOT, R.V. – (1997) . " Reflexões e propostas sobre o "Ensinar Engenharia" para o Século XXI ". São Carlos. 113p. Tese (Livre – Docência) - Escola de Engenharia de São Carlos, Universidade de São Paulo.

SE063512

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Kolb's Learning Cycle: An Alternative Strategy for Engineering Education

Author(s): Nídia Pavan Kuri

Corporate Source:

Publication Date:

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY
Sample	Sample	Sample
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
1	2A	2B
Level 1	Level 2A	Level 2B
☒	☐	☐
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) and paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, → please

Signature: N. Kuri

Printed Name/Position/Title: Nídia Pavan Kuri

Organization/Address: School of Engineering of São Carlos, University of São Paulo, 13560-250 - São Carlos - SP - Brazil

Telephone: 55 16 2739239

FAX: 55 16 2719241

E-Mail Address: [illegible]

Date: 02/06/2000