Designing problems for problem-based learning courses in analogue electronics: Cognitive and pedagogical issues *

A Mantri †
Chitkara Institute of Engineering and Technology, Punjab, India

S Dutt
National Institute of Technical Teachers' Training Institute, Chandigarh, India

JP Gupta
Jaypee Institute of Information Technology, Noida, India

M Chitkara
Chitkara Institute of Engineering and Technology, Punjab, India

SUMMARY: *Designing problems for problem-based learning (PBL) courses in engineering has always been a challenging task, especially in environments where the only method of imparting technical education has been through traditional a lecture/tutorial/practical (L/T/P) approach. This paper describes the cognitive and pedagogical issues involved in conducting a PBL course in analogue electronics, designing of problems, analyses of solutions submitted by the student groups and how learning objectives were achieved. It also presents a detailed analysis of the problem statements designed and open-ended metacognitive triggers built on PBL students thinking, to understand how the facilitator supported the collaborative knowledge construction. The knowledge and skill tests scores of both the traditional and PBL threads are presented and compared.*

1 INTRODUCTION

From a constructivist's perspective, discourse is a central mechanism for learning (Palinscar, 1998). For ages, educationalists have been working on making the "theory" as practical as possible and making the "practice" as theoretically interesting as possible. This effort is the guiding force to relate constructivism as theory of learning to the practice of instruction (Savery & Duffy, n. d.). Constructivism is a philosophical view on how we come to understand or know, and the instructional principles guide us in the practice of teaching and the design of learning environments. Orchestrating constructive discourse is a complex process, whether in a classroom or otherwise (Leinhardt, 1993). Over a period of time, ever since the need to introduce problem-based learning (PBL) was understood and practiced in engineering courses the world over, its positive effects have been discussed and published time and again (Cooper, 1997; Besterfield-Sacre et al, 1997; Albanese & Mitchell, 1993). While the knowledge construction is structured, but limited, in a teacher centered classroom, the same is much more complicated, but elaborate, in the student centered approach. In PBL, thus, when the teachers and students co-construct the instructional agenda in a student centered classroom, the role of the facilitator becomes very critical as he has to juggle with many simultaneous goals and has to coordinate pedagogical actions with semantic knowledge.

In India, particularly in North India, where approximately 39 engineering colleges are established with an annual intake of 16,000 students, no instance of practicing PBL is known. Thus, the only method of imparting technical education in degree courses is the traditional lecture/tutorial/practical (L/T/P) approach. Encouraged by the success of PBL in

---

* Paper D07-023 submitted 3/08/07; accepted for publication after review and revision 10/12/07.

† Corresponding author Assistant Professor Archana Mantri can be contacted at archana.mantri@chitkara.edu.in.

engineering courses (Maskell & Grabau, 1998; Striegel & Rover, 2002; Linge & Parsons, 2006) elsewhere in world, and considering the importance of analogue electronics as a basic subject in the curriculum of electronics and communication engineering, PBL was introduced in this course using a two threaded approach. The existing class of 132 students was split into two parts – the Control Group (CG) and the Treatment Group (TG). The selection of students for PBL was random.

As the students went through the ups and downs of PBL and team work, progressive improvement in their knowledge, technical and communication skills, and attitude was seen and tabulated by taking periodic reflections and evaluations. In the end, their performances were compared using common tests, designed to include all aspects of knowledge and skill. This paper highlights the designing of problems; cognitive and pedagogical issues while conducting the course; analyses of solutions submitted by the groups; and the difference in the performance of CG and TG.

2 COGNITIVE AND PEDAGOGICAL ISSUES

2.1 Syllabus of analogue electronics

The syllabus of Analogue Electronics (Theory) EC202 is set to cover the following topics:

1. high Frequency analysis of transistors
2. large signal amplifiers
3. multistage amplifiers
4. feedback in amplifiers
5. oscillators
6. regulated power supplies.

The experiments are made to include following tasks in the practical component EC210 (Palinscar, 1998), which are broadly classified as:

1. to study the characteristics of all types of large signal amplifiers
2. to study the response of all types of sinusoidal oscillators
3. to study the working of a regulated power supply.

2.2 Time allotment, teaching pedagogy and evaluation strategy

The existing class of 132 students was split into two groups: the TG was taught using PBL and the CG was taught by L/T/P. Initially 25 students were randomly selected for the TG. However, after one session, four of these students left and the TG finally had 21 students. The same tutor taught both the classes. The students in the TG did not know that they were being taught using PBL. To parallel the time allotment of both TG and CG, the total duration of 14 weeks at the rate of 8 hours per week allotted to the subject was divided into four PBL sessions of 2 hours each. The demarcation of lecture, tutorial and practical was removed and the students were made to sit in their specially designed classrooms, which had circular tables and a small library (which contained course and reference books, and computers with internet and circuit simulation software).

Not truly open ended, but problems broad enough, were then framed in accordance with the topics in the syllabus. A number of technical nodes or learning outcomes were defined and learning objectives were identified, in consultation with the senior faculty members teaching that subject. A practical problem of "small home application", which was further subdivided into five smaller problems, was given to the students. Each problem was to be attempted in 10 sessions each. The time distribution was as given in table 1.

The PBL sessions, group discussions and seminars were analysed on the basis of technical nodes covered, questions asked, and the statements made by the facilitator and the students. Similarly, the problem solutions submitted by the groups were analysed in terms of various technical nodes covered and the learning objectives achieved. For students in CG, a lecture plan was prepared and the subject matter was covered using L/T/P method.

In the end, the knowledge and skills of both the TG and CG were analysed and compared. For making the evaluation strategy parallel, the total internal marks of 70 were reassigned to include the peer evaluation factor and problem solutions factor in the TG.

2.3 Cognitive issues

The knowledge in technical fields and subjects should not be limited to the systems defined by and to the experiences of the teacher. Thus, within those disciplines that are systematic and experience based, such as management of construction, there

Table 1: Time allotment.

Total time available	14 weeks
Combined study of first topic in the course	1 week
Total number of PBL sessions at four sessions per week	13 x 4 = 52 session
Number of sessions per problem	52/5 = 10
Actual work on the problem	7 sessions
Group discussion	1 session
Solution presentation	1 session
Assignment practice	1 session

is always a need for an approach that is not reliant on the particular knowledge base of the teacher. "Educationalists are often inadequately equipped to provide much of the useful knowledge and skills needed by practitioners" (Stratton, 1985), so it is understandable that there has been a move to include elements of PBL within traditional courses without changing the underlying structure of the program.

In place of traditional learning materials where content notes, topical or subject descriptors and textbooks are given, students instead grapple with a fuzzy problem and try to understand the scope, issues and concepts stemming from or inherent in the problem before attempting to identify learning points that will guide them towards the formulation of an eventual response (be it in the form of a theory, hypothesis, solution or argument).

We have tried here to provide a clear link between the theoretical principles of constructivism as a theory of learning to the practice of constructivism, the practice of instructional design and the practice of teaching. There are many cognitive activities involved in teaching and different strategies to actively engage students. There is the teacher centered approach and there is the student centered approach. In traditional classrooms, usually teachers ask 95% of the questions, which mostly require short answers (Grasesser & Person, 1994). Thus the goal of many teachers is to make students learn facts. However, in technical education, the goal should be to make students learn theories and how are they derived. This includes having students learn what questions to ask, how to make predictions and how to test theories. In other words, teachers should be enquiry teachers, who use questioning techniques to promote deep thinking among students. In PBL, the teacher is an enquiry teacher or a facilitator, and makes the classroom environment conducive for the students to be more active. However, he has to still lead the discussion, working towards the global goals, but choosing strategies on the fly (Hmelo Silver, 2002).

2.4 Technical issues

Apart from the role of facilitator, the designing of problems and then gauging their effectiveness in conducting the course is also critical. In order to gauge the effectiveness of the PBL program and of the problems, in each topic a number of learning outcomes or technical nodes were defined that were required to be achieved, in order to achieve as many learning objectives as possible. This was done by listing the set of technical nodes under each topic and getting it authenticated by senior teachers. Although no set of technical nodes and learning objectives can be complete, an effort was made to have all relevant ones listed. The number of technical nodes and learning objectives identified per topic are listed in table 2.

Example of technical nodes and learning objectives are:

Topic – Large signal amplifier

Technical nodes –

1. Recall the concept of biasing of transistors.
2. Identify and describe three regions of operations of transistor.
3. Develop, understand and apply the formulae of amplifications (current, voltage and power); recognise, compare and describe circuit diagrams of class A, B and C amplifiers etc.

Learning objectives –

1. The students should be able to classify large signal amplifiers in light of the biasing of the transistor.
2. The students should be able to decide which amplifier to use for a particular application and complete the design process for this large signal amplifier, with the given specifications.
3. The students should be able to troubleshoot a faulty design of a large signal amplifier and rectify it for appropriate working.

3 CONDUCT OF COURSE

3.1 Technical nodes and learning objectives

During the conduct of the PBL course, the students, under the guidance of facilitator, tried to cover, but did not limit themselves to, as many technical nodes and learning objectives as possible. The facilitator also asked the students to mention all learning, technical

Table 2: The number of technical nodes and learning objectives identified per topic.

Topic	Number of maximum technical nodes	Learning objectives
High frequency analysis of transistors	10	4
Large signal amplifiers	25	7
Multistage amplifiers	26	5
Feedback in amplifiers	15	7
Oscillators	24	5
Regulated power supply	9	4

issues, failures, findings, sources, interpretations and explanations in the problem solutions. It is appropriate to mention here that, while the problems were meant to infuse inquisitiveness, build the concept and learn about the theories, the practice part was taken care by making the students practice assignments and tutorial sheets. After the receipt of solutions by the groups, these were analysed in terms of technical nodes covered and learning objectives achieved. The results are tabulated in table 3.

Group 2 almost always covered approximately the same number of technical nodes as the maximum. In contrast, Group 5 initially covered least number of technical nodes and then slowly rose to cover the same number of technical nodes as the maximum.

3.2 Decoding of transcripts

The entire transcript of all the groups was individually recorded and was coded for the types of questions and statements in the discourse. These were coded using taxonomy of questions types and several additional categories that were developed to capture monitoring, clarification and group dynamics questioning. The major categories of questions were short answer type, long answer type and meta. Similarly, statement types were recorded according to new ideas, agreements, disagreements, conclusive, inferences, wrong interpretations or metacognitive statements. Although this recording was done for each group separately and also during the group discussions and presentations, the results here are being reproduced for two groups – one in which maximum number of technical nodes were covered and for the group for which minimum number of technical nodes were covered. The data is reproduced for three problems in table 4.

3.3 Examples of triggers

Words like "determine", "draw", "comment" in the problem statements were used to cover various domains in the cognitive domain. While the terms "Q-point", "biasing resistors", "cut-off", "below cut-off", "current gain", "voltage gain" and "power gain"

Table 3: Number of technical nodes and learning objectives achieved.

Topic	No. of maximum technical nodes	No. of technical nodes covered by Grp1 to Grp5					Average no. of learning objectives achieved by groups
		Grp1	Grp2	Grp3	Grp4	Grp5	
High frequency analysis of transistors	10	10	14	13	9	7	4
Large signal amplifiers	25	24	25	26	19	14	7
Multistage amplifiers	26	23	27	24	26	16	5
Feedback in amplifiers	15	14	15	17	15	12	7
Oscillators	24	23	24	28	20	20	5
Regulated power supply	9	8	9	8	7	8	4

Table 4: Classification of question and statement types for three problems.

		Grp1 facilitator	Grp 1 students	Grp5 facilitator	Grp 5 students
Question type	Short answer type (inclusive of verification, concept completion, disjunctive, feature specification)	4, 12, 13	167, 121, 97	13, 12, 21	94, 102, 56
	Long answer type (inclusive of definition, comparison, interpretation, causal antecedents)	10, 17, 19	27, 45, 19	9, 10, 15	18, 29, 9
	Meta (inclusive of group dynamics, monitoring, clarification, request)	53, 45, 67	46, 34, 47	65, 59, 75	38, 36, 41
Statement type	New ideas	4, 5,6	15, 15,18	8,9,10	10, 4, 8
	Modifications	10, 0, 1	12, 18, 15	12, 4, 2	8, 5, 8
	Agreements and disagreements	0, 2, 5	19, 19, 10	0, 4, 6	9, 2, 5
	Meta	4, 6, 9	4, 7, 8	8, 6, 8	9, 7, 9
	Conclusions and inferences	2, 4, 2	6,10, 14	3, 5, 7	3, 7, 7

relate to the previous knowledge base of the students. In addition, some, but not all, triggers used were:

- Is it all? Perhaps you could verify it on the software, try some more combinations of biasing resistors or try your hand on the practical board to authenticate.

Some, but not all, comments of the students are listed below:

- The given combination of biasing resistors is completely invalid. It doesn't satisfy Kirchoff's Voltage Law (KVL) and Kirchoff's Current Law (KCL).
- Maybe, we first verify in the book.
- We will have to try some different combinations of resistors.
- We have heard of active, cut-off and saturation regions of the transistors, but what is "below cut-off"?
- When we apply the signal to this configuration, the signal clips off from the bottom. I wonder what might be the use of such an amplifier configuration?
- Although the voltage amplification is good, I see that there is no appreciable gain in the power. Why it might be so?
- This software has various components in the library, and I can place them too, in the worksheet area joining them as I like. Let me find out if it has some simulation tools too.
- There can be so many combinations of biasing resistors for the same transistors. Which one can be the best?

Triggers supplied by the facilitator:

- But the power is too large to be delivered to the output.
- Consider redistributing your work.
- Add this to your learning objectives
- Verify your calculations.
- We can discuss it in the GD at the end of the class. Collect the facts in support of your theory.
- Why don't you consult some specification sheets of power transistors in the data sheets?
- But the efficiency is too less (or more).

By the students:

- Let us try replacing the load in the amplifiers developed in problem 1.
- But we saw that the voltage amplifiers need not necessarily give power amplification too.
- Let us refer to the literature.
- Can I find some pre-calculated things on the net?
- Let us calculate the values to find out the values of power amplification.
- Since there are so many classes of amplifiers, let us design each one of them for this value of power output.
- Will the same transistor as in problem 1 work?
- My resistor of 20 Ω got burnt while doing the practical. Why? Even the transistor is getting heated up.
- How do I actually measure power to find the power amplification?
- Why is the push-pull configuration or complementary-symmetry configurations so called?
- I have only a particular transistor available for authenticating my result practically, while I did my design calculations without bothering whether the transistor is available in the lab or not. Now what to do?
- I am getting a large variation in theoretical, software and practical results. Are we wrong? Can we account for our errors?

4 PROBLEMS ASSOCIATED WITH THE PBL CLASS

In PBL, the students do a substantial amount of question asking and subsequent discussion supported by metacognitive triggers from the facilitator to aid the students to move through the complex conceptual space and achieve the learning objectives.

The role of the facilitator in the face-to-face discussion has several aspects. Not only did the facilitator need to manage time, but also keep in mind what maximum technical nodes were covered and learning objectives were achieved. The flow of ideas should touch the deep conceptual level and at the same time move to presentation levels. The most difficult role of the facilitator was to keep the groups moving and make sure that everyone participated. At the same point of time in the PBL class, one group would be appear to be out of sync with the time frame and another group might be converging too fast, so that the learning objectives might not be achieved. The types of triggers would then have to be different for the two groups at the same time.

PBL provides a well described and discussed approach to constructivist learning. However, it is labour intensive and requires a trained facilitator for each group of students. Facilitation is quite difficult for novices (Derry et al, 2001). Not only technical, but psychological issues of group dynamics are also to be tackled by the facilitator. Some of the difficulties, the author faced, while working with this particular PBL class were:

- At the point of time that the students were introduced the peer evaluation factor, they became apprehensive about the fact that their own peers might not give them good points and their overall score would suffer. But as they progressed, and they understood group dynamics, they could understand the importance of this factor and soon came to terms with it. They could realise that the only way to grapple with so many simultaneous goals is only to distribute the work among group members, pool in the data and information, and work to the full honestly; lest a group member is left behind and he gives a negative mark to all other team members, affecting the scores.

- At times, the competition among various teams was fierce and the groups worked less on traversing the conceptual space and more on making their presentations more effective. The facilitator would then have to counsel the students to strike a balance.
- The use of simulation tools and the MULTISIM software would take undesirable proportions, and students would use the simulation tools as a substitute for essential calculations that should be done to design and analyse a circuit.
- The most frequent problem encountered was that of group members worrying about following a particular approach. The facilitator had to continuously align and misalign the groups from finding the answers to the problem. The misalignment was required so that while trying to find out the correct solution to the problem, maximum learning objectives are achieved. The alignment was required so that the learning curve did not diverge much from the ideal curve of learning within the set time frame.
- Though still in the transition phase from L/T/P to PBL, and because of the limitation on the class size that could be handled with PBL, a two-threaded approach was used. The students in PBL, initially, would always see the short-term achievements of the L/T/P class and would keep questioning the facilitator about the learning being achieved in the two sections. But as the time passed on, PBL students could understand the pedagogy and cognition differences of the two sections and could parallel the learning objectives.

5 RESULTS AND ANALYSIS

5.1 Analysis of statement types and technical nodes

By observing table 4, out of the total questions asked while solving three problems, 270 were asked by the facilitator, while 603 were asked by the students. There seems to be a direct relation between the technical nodes covered, learning objectives achieved and the number of questions asked. Group 5, which covered least number of technical nodes, asked less questions, as compared to Group 1, which covered the maximum number of technical nodes. Similarly, Group 5 made less statements as compared to Group 1. On the contrary, the number of questions asked by the facilitator bears inverse relationship with the technical nodes covered. This might be because of the fact that when the facilitator observes that the required number of technical nodes are not being covered, he tries to motivate the group by asking more questions and giving more metacognitive triggers.

If the questions asked by the facilitator are compared, with any group and with any problem, short answer type questions are far less in number as compared to long answered questions. This is because the facilitator wanted to ask less content-focused questions in order to build discourse of knowledge construction. The few content-focused questions asked were to focus attention. During the assignment sessions, and particularly during second and third sessions, there was a drop in the number of statements and questions in the discussion. This was because, while the facilitator used this time to observe and evaluate the direction taken by each group, the students spent time in independent research, and spent time in focusing, grasping, refining and elaborating their ideas. Observing the number of statements and the massive number of questions that were being put forth by the students provides a window into students' collaborative knowledge construction. If the discussion were student centered, then it is reasonable to expect the students to do most of the talking. The role of the facilitator is to introduce new ideas, and question the findings and their relation to inferences drawn. Also he offered a statement or a metacognitive trigger whenever a poorly elaborated idea was likely to become a learning issue. Most of the intervention was required at the time of doing practical and authenticating the theoretical results by way of experimentation.

5.2 Measurement of knowledge and skill

Knowledge and skills were measured using the two components of internal and external evaluation. The external component for gauging their knowledge was the end of semester theory paper of 60 marks. The bar charts of the students in TG and CG are given in the form of bar charts in figure 1.

However, in order to gauge the design and synthesis skills of the students at the end of the term, a small project was given to all the students in the class. The students were given two separate wired circuits on bread boards, with a single fault introduced in each circuit. The students had to draw the circuit by tracing the connections, find the faults, rectify them and make the circuits work. While TG students were allowed to work in their groups, the CG students were also allowed to make groups and find out a workable solution to the project in a span of 4 hours. A team of four senior faculty members then evaluated the projects on a predefined strategy. Results showed

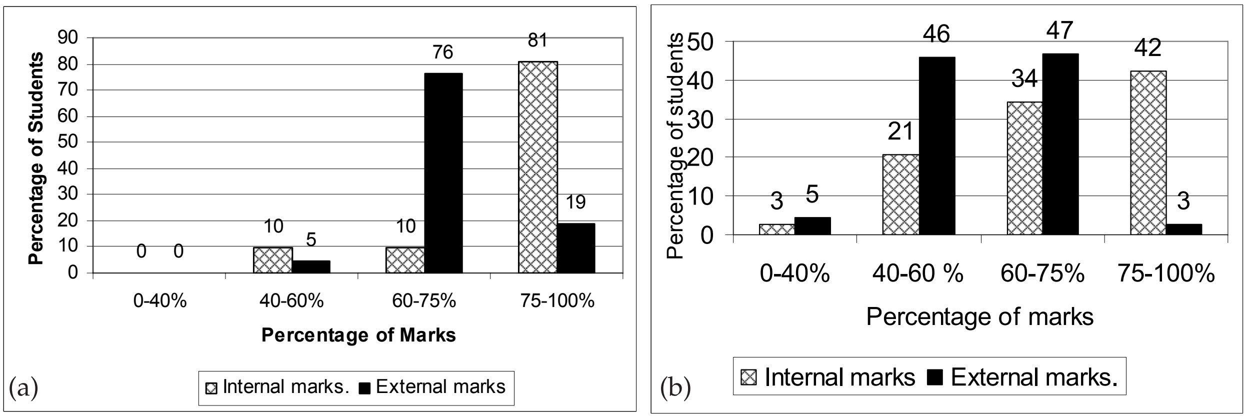

Figure 1: (a) Bar chart analysis of TG PBL student results. Internal marks had mean and standard deviation of 86.6 and 3.9, respectively, while external marks had mean and standard deviation of 70.2 and 3.9, respectively. (b) Bar chart analysis of CG traditional L/T/P student results. The internal marks had mean and standard deviation of 70.6 and 14.4, respectively, while external marks had mean and standard deviation of 58.4 and 10.8, respectively.

that four of the five groups in TG scored more than 60%, while only one group in the CG could score more than 60%. This was a clear indication of better skills acquired by the TG students, both in terms of working in teams and in practical skills. In order to gauge the effectiveness of the course conducted, a questionnaire was circulated among all the 132 students (Mantri et al, n. d.). An overwhelmingly positive response was obtained for the PBL course (Mantri et al, n. d.).

6 CONCLUSION:

The PBL-based course of Analogue Electronics was conducted in an environment that otherwise would have involved only a L/T/P approach. The pedagogy involved designing problems that covered the scope of the subject; carefully listing technical nodes and objectives; and handling the course, class, students and their psychological issues, besides the technical ones. They were all challenging tasks. The student sessions, group discussions, presentations and the submitted written solutions were recorded and analysed for cognition and knowledge construction. It was inferred that there exists a direct relationship between the technical nodes covered, number of statements made and questions asked to the scores the students achieved. However, continuous facilitator intervention was required to help students cover maximum technical nodes and learning objectives. Knowledge was constructed and the conceptual space was traversed by the groups of students without any lecturing done by the tutor. The knowledge test conducted showed that the PBL group scored better. The skill test showed remarkably better performance by the PBL group, compared to traditional group. The authors now intend to use open source software Moodle for providing chat forums and recording of classroom proceedings. Using such software would not only extend the classroom time beyond physical interaction during college hours, but would provide an excellent way of recording and processing the discussions.

REFERENCES

Albanese, M. A. & Mitchell, S. 1993, "Problem-based learning: a review of the literature on outcomes and implementation issues", *Academic Medicine,* Vol. 68, pp. 52-81.

Besterfield-Sacre, M. E., Atman, C. J. & Shuman, L. J. 1997, "Characteristics of freshman engineering students: models for determining student attrition and success in engineering", *Journal of Engineering Education,* Vol. 86, No. 2.

Cooper, J. L. 1997, "New evidence of the power of cooperative learning", *Journal of Cooperative Learning and College Teaching,* Vol. 7, no. 3, pp. 1-2.

Derry, S. J., Lee, J., Kim, J.-B., Seymour, J. & Steinkuehler, C. A. 2001, "From ambitious vision to partially satisfying reality: community and collaboration in teacher education," AERA Annual Meeting, Seattle, Washington, April.

Grasesser, A. & Person, N. 1994, "Question asking during tutoring," *American Educational Research Journal, Vol. 31, pp. 104-137.*

Hmelo Silver, C. E. 2002, "Facilitating collaborative knowledge construction", *Proceedings of the 36th Hawaii International Conference on System Sciences (9HICSS'02),* IEEE, Rutgers University.

Leinhardt, G. 1993, "On teaching", in *Advances In Instructional Psychology,* Glaser, R. (editor), Erlbaum, Hillsdale, NJ, pp.1-54.

Linge, N. & Parsons, D. 2006, "Problem-based learning as an effective tool for teaching computer network design", *IEEE Transactions on Education,* Vol.49, No.1, February.

Mantri, A., Dutt, S., Gupta, J. P. & Chitkara, M. (n. d.), "Design and evaluation of PBL based course in analogue electronics", *IEEE Transactions of Education,* accepted for publication.

Maskell, D. L. & Grabau, P. J. 1998, "A multidisciplinary cooperative problem-based learning approach to embedded systems design", *IEEE Transactions on Education,* Vol. 41, No. 2, May.

Northwood, M. D. & Northwood, D. O. 2003, "Problem based learning (PBL): From health sciences to engineering to value added in workplace", *Global Journal of Engineering Education,* Vol. 7, No. 2, UICEE.

Palinscar, A. S. 1998, "Social constructivist perspectives on teaching and learning", *Annual Review of Psychology,* Vol. 45, pp. 345-375.

Savery, J. R. & Duffy, T. M. (n. d.), in *Constructivist Learning Environments: Case Studies in Instructional Design,* Wilson, B. (editor), Education Technology Publications, Englewood Cliffs, NJ.

Stratton, A. 1985, "Problem based learning and academic-practitioner gap", in *Problem Based Learning in Education for the professions,* Boud, D. (editor), HERDSA, Sydney.

Striegel, A. & Rover, D. T. 2002, "Problem based learning in an introductory computer engineering course", 32nd frontier ASEE/IEEE frontiers in education conference, 6-9 November.

ARCHANA MANTRI

Archana Mantri received her MTech (Digital Communication) degree from National Institute of Technology, Bhopal, India, in 1999. She is presently working as Director Academics at the Chitkara Institute of Engineering and Technology, Punjab, while pursuing her doctoral research in electronics and communication engineering and education technology. Her areas of interest include circuit theory and analysis, digital communication, and education technology.

SUNIL DUTT

Sunil Dutt holds a PhD in Education. He has published widely in the psychology of adult learning and performance evaluation. His areas of specialisation include research methodology, measurement and evaluation, and educational management.

JP GUPTA

JP Gupta has a PhD in Computer Science and Engineering from the University of Westminster, London. He is an alumnus of Banaras Hindu University and the Vice Chancellor of Jaypee Institute of Information Technology University, Noida, India.

MADHU CHITKARA

Madhu Chitkara holds Doctorate degree in Education. Her areas of interest include education technology, pure mathematics, architecture and governance. She is the Director of Chitkara Educational Trust, Chandigarh, India. She is active in bringing revolutionary changes in the educational scenario of the region of the Punjab, India, and is the recipient of Rashtra Vikas Ratan Award from NEHEG, India.