

The Curriculum is Dead - Long Live the Curriculum!

Trond Clausen
Associate Professor, Telemark University College, Norway

Introduction

Engineering education is under pressure, at least in the western world. The pressure is coming from industry, from public utility companies, from politicians, and not at least, from within the universities and colleges themselves. The root for this pressure is obviously the structural changes observed in the "industrial world" leading to engineers laid off by hundreds of thousands [1].

This continuing pressure often concentrates about a few focal points:

1. The need for changing the curriculum.
2. The need for changing the educational methods.
3. The need for changing the teacher.

At the present Telemark University College, these challenges have been taken seriously, leading to what (in Norway) has come to be known as the "Telemark" model, often referred to as "Project Oriented Studies" or "Problem-Based Learning", PBL.

In order to demonstrate some examples of "curriculum generation" done by student groups, the outline of this paper is:

1. Very briefly describe the "Telemark" model of cooperative learning.
2. Shortly discuss the 3 points mentioned above with respect to the "Telemark" model.
3. Show that the "Telemark" model students are able to define their own curricula - precisely meeting their needs when it is needed.

This documentation will be based on a few and merely arbitrarily chosen examples from the Electrical Engineering Department after almost 2 decades of experience with cooperative learning.

The "Telemark" Model

The "Telemark" model is a slightly modified version of the pedagogic approach used at the University of Aalborg, Denmark.

Engineering education at Telemark University College lasts for 3 years, each year is divided into 2 semesters. The semesters are numbered from 1 to 6, where the 6th semester is the semester of graduation.

The "Telemark" model is characterized by the group, the project, the adviser, the documentation, and the evaluation.

1. The Group. A group consists normally of 4-7 students but special arrangements may be made on demand. The group is expected to constitute themselves, define standards for group behavior, exert self justice etc. The group is officially organized for the project oriented part of the studies. But many group members are cooperating also in courses taught in traditional ways.
2. The Project. There are different types of projects:
 - First Semester's Project should have a broad scope, dealing with general problems of interest to society at large. Ideally, this project is supposed to introduce the student to a scientific way of thinking, working and writing. The topics may be chosen by the group from a list set up by the teacher.
3. The next semesters' technical projects are often carried out in cooperation with industry or public utility companies. The problems are usually assigned by the teacher.
4. Sixth semester's project (main project, 60 % of the semester or more) is a technical project given by the teacher or others.

Common to all projects: The group members are required to present their project report orally to an audience.

5. The Advisers. Each group is assigned one adviser and one censor. These are normally members of the ordinary staff. A handbook has been worked out to assist advisers and students during the process.

6. The Documentation. The group's activities and progress should be documented by a "project file" containing notes etc., a "process description" where the group is evaluating their progress, and the formal report.
7. The evaluation. There is a pass/fail system. Only the final report is graded, with individual grades for each group member.

Change of Curriculum

The "Telemark" model is, depending on the engineering departmental needs, allocating 25-30 % of the total organized time for project work. The rest of the weekly schedule is, like mentioned above, filled with "traditional activities".

The technical content of the project work can only partly be selected and controlled by the teacher, who will play a less active role to provide useful learning material. Instead: Cooperative partners outside the college will have (and use) the opportunity to influence the college directly through student work. Experience is showing that teachers are indeed learning from their students' reports and often include material from these in their own classroom work.

An important aspect of the "Telemark" model is the opportunity of specialization - limited by the narrow frames given by the 3-year's program. Examples will be given under the heading ""New" Curricula Served à la Carte" at the end of this paper.

Change of Educational Methods

Compared to what has been referred to as "traditional activities", project oriented studies mean a change of methods.

The change is fundamental since the objectives of project oriented studies are something more than just replacement of a curriculum: While a "traditional" program normally emphasises certain selected fields of specific knowledge, project oriented studies are trying to realize objectives like [2]

1. Teach the fundamentals.
2. Help the students learn how to learn.
3. Provide the students some training in solving problems.

Done successfully, project oriented studies should have the ideal objective of helping the students learn to know themselves, making them fit for working in a constantly changing world.

Change of the Teacher

The ideal role of the teacher serving as an adviser, may be formulated like this:

The real challenge in college teaching is not covering the material for the students, it's uncovering the material with the students.

Consequently, the adviser needs neither be the expert of the topic chosen by the group nor in command of the group process. In stead, the adviser should be the *insightful leader* letting things happen.

This change may be described as fundamental. Maybe the "change of the teacher" will be the key element in restructuring engineering education for tomorrow's needs?

The Curriculum is Dead

The changes listed above seem to lead to one inevitable conclusion, applying to the fundamental engineering education: Except for the basic courses, the curriculum as we used knowing it, is dead.

Long Live the Curriculum

However, the partial shift of responsibility from the teacher to student groups will, as it has been noticed f.inst. at Telemark University College, lead to the growth of "new" curricula.

The "new" curriculum may include tangible as well as intangible features:

Among the *tangible* aspects are training in practical leadership, formalities with respect to handling formal meetings, following up meetings, the preparation and implementation of oral presentations, basic technical writing including style, grammar, spelling etc., and - of course - training in finding and applying appropriate technical solutions even in fields which are not being taught at the college.

Some *intangible* parts of the "new" curriculum include experience with a variety of group psychology processes, development of personal attributes as creativity, social adjustment, responsibility, flexibility, initiative, courage and

perseverance.

"New" Curricula Served á la Carte

As mentioned earlier, an arbitrary set of technical curricula will emerge under a cooperative learning system like the "Telemark" model. From the Electrical Engineering Department of Telemark University College are listed some examples of main projects. They have in common the investigation and proposal of solutions to problems outside what is normally being taught at the department.

In the presentation given below, only some *tangible* elements of the curriculum are taken into account.

Project

"New" elements of curriculum

- | | |
|--|--|
| 1. The Control of a Bickley Furnace | 1. Drafting, practical implementation of control theory |
| 2. Laboratory transformer analysis | 2. Harmonic problems, Fourier analysis |
| 3. Planning a new control room | 3. Drafting, introduction to different unknown components |
| 4. Upgrading a secondary transformer station from 66 to 132 kV | 4. Drafting, applied engineering mechanics, calculation of volume and rentability |
| 5. Remote control of Brevik transformer station | 5. Drafting, new components, remote control principles |
| 6. Transient study of a PWM drive for sawmills | 6. Measurement at high frequencies, interpretations |
| 7. Planning a new 22 kV power line | 7. Drafting, engineering mechanics, use of modern surveying instruments |
| 8. Upgrading an offshore valve controlled pump drives to PWM adjustable drives | 8. Drafting, economical analysis, combining electrical and mechanical units on the axis |
| 9. Upgrading industry valve controlled pump drives | 9. Drafting, economical analysis, practical engineering planning |
| 10. Phase compensation of Drammen power company | 10. Use of a modern, complex computer program, economics |
| 11. Lightning arrester for a 50 Hz test station | 11. Measurement techniques, traveling wave studies |
| 12. Energy conservation at a vocational school | 12. Heat pump, economics, analysis of heat transfer |
| 13. Energy conservation at a large car dealers | 13. Heat transfer, 2-way's communication power company and customer, the new relationship power company/customer |
| 14. Alternative energy sources | 14. Anything but hydroelectric power |
| 15. Electrical engineering to assist the improvement of women's conditions in developing countries | 15. A field trip to Nepal, leading to an analysis of which conditions (social, religious, political, economical etc.) to be altered before solving <i>this</i> problem |

References:

1. IEEE Spectrum: December 1990, August 1993 and November 1994
 2. Marion Hagler: Newsletter of IEEE Education Society and ASEE Electrical Engineering Division, Spring 1994
-