Abstract.

Recently a new teaching concept has been proposed by the Board of Governors of the Noordelijke Hogeschool Leeuwarden in The Netherlands. In our Engineering Department some parts of this concept were already a reality. It also supported our teaching philosophy and stimulated us to evaluate and to improve our teaching concept. This paper describes in concise form the Dutch system of technical education, the new teaching concept and some of its effects on current EE course projects.

1 Introduction.

This paper describes an innovation, in part, of the teaching concept in the Electrical Engineering’s (EE) project class at the Noordelijke Hogeschool Leeuwarden, (NHL), Department of Engineering. The basic reason for this innovation was the Board of Governor’s introduction of an elaboration on the teaching concept in the form of ten points of reference defined in three sub areas. In turn, the ten point of reference were the result of an university-wide program to improve the feasibility and the quality of the course program. These points of reference are intended to stimulate a review, an evaluation and an improvement of the teaching and its effects on project-courses for second year Electrical Engineering students.

The remainder of the paper is organized as follows: section 2 presents an introduction to the Dutch system of technical education; section 3 describes a brief introduction of the EE project-course; section 4 is dedicated to the points of reference; section 5 gives an evaluation of the EE project-course; the paper ends with some conclusions.

2 The Dutch system of technical education.

Basically, the current Dutch system of technical education can be divided into 3 levels.

Level 1: the Lower Technical School (LTS), which is a 4-year vocational school; supported by theoretical subjects, the emphasis of the training is on manual skills.

Pre-requisite : 8-year basic school.

Level 2: the Middle Technical School (MTS), which is a 4-year school; although manual skills are still important, intellectual abilities are more required.

Pre-requisite : LTS or MAVO ( which is a 4-year course of general nature after the basic school).
Level 3: there are two types of Universities on this level with a differences that lie in the approach.

a) this is a more ‘practical-oriented’ University. The School of the Build Environment is the official interna-tional name given by the Ministry of Education. Traditionally the abbrevia-tion HTS (Higher Technical School) is employed it’s roughly the equiva-lent of an former English Polytechnic or a German Fachhochschule. Pre-requisite : MTS or HAVO ( a 5-year course of a general nature after the basic school). Graduate students receive a ing. degree what is equiva-lent to the B.Eng. or B.Sc. degree.

b) the Technical University (TU) ; This University has a more theoretical/ scientific approach. Pre-requisite : VWO ( a 6-year course of a general nature after the basic school). Graduate students receive a Ir. degree what is equivalent to the M.S. or M.Sc. degree.

The institute regarding this paper is the Technical University with the more practical-oriented approach, level 3,a. This is a 4-year course with three distinct parts:

- the first two years are basic; in the second year some specialization is allowed;
- the third year is spent in industry under the supervision of the academic staff; this term is considered of great importance;
- in the fourth year the student returns to school; an area of specialization is com-pulsory; the final year is concluded with a qualifying examination in the first half and a final project in the second half.

Traditionally the largest part of students entering our institute had a MTS preparatory training. At the moment 70% of the type of student that enters has a HAVO preparation. The reason for this tendency is the turn over of the MTS into a more occupational training, vocationa school.

3 A introduction to the EE project course.

Project and practical courses have always been a very usual type of course in our technical education. At the moment there is an increa-sing worth at the institute for project type courses. Differentiation has a positive effect on individual student development, efficiency and functional thinking.

There is a variety of objectives in project cour-ses. The intention is to achieve generic capabi-lities which enable people to succeed in different tasks and jobs. Therefore in general during project courses 45, the following items are of importance:

1. stimulate the practice of theoretical knowledge achieved in lessons.

2. appeal to the students;
   - independence
   - motivation
— initiative
— responsibility
— decision-making
— problem-solving thinking

3. the individual student gains experience and skills in;
— specifying
— communication
— teamworking
— retrieve and obtain information
— management
— leadership
— planning and organization
— reporting and documenting
— cost calculations and control

The goal in the EE project is to engineer and realize some electrical or electronic device, where the emphasis is more on the engineering part instead on the realization. To guide the students in their project and to achieve a uni-versal approach a 5-phase project management prescription with 5 step in each phase was introduced, i.e.:

Planning phase: 1 - definition
2 - specifying
Implementation 3 - organization
4 - controlling
5 - closing

The EE project course is scheduled in the second year and starts in September and finishes in June. The time schedule with 5 week periods is as follows:

<table>
<thead>
<tr>
<th>per.</th>
<th>class hours each week</th>
<th>proj. phase</th>
<th>activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1,2</td>
<td>introduction selecting task setting up; specs, planning, cost accounting.</td>
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<tr>
<td>2</td>
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<td>final; specs, planning, cost accounting. progress report.</td>
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<td>4</td>
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<td>3,4</td>
<td>realization</td>
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<td>5</td>
<td>2</td>
<td>3,4</td>
<td>realization, testing</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>5</td>
<td>documentation presentation</td>
</tr>
</tbody>
</table>
Depending on the scale and diversity of the project, students work alone or in teams with a maximum of 4 students. Groups larger than 4 students require stronger leadership which is often inappropriate within an academic context. Usually the students are allowed and are very capable to choose their own groups. They are familiar with each individual skills and expertise and so they complement each other. The subject or project task is usually free for the students to contribute or in some cases to select from a list of project task suggestions. This approach for selecting the team and project task contributes to the student’s and teacher’s motivation.

During project hours students work in a surrounding which is intended to be a reflection of the professional practice. The available laboratory has a number of necessary machines and facilities to realize the electrical or electronic device.

When the EE project period finishes in June a exposition market is organized on the final day of the year where all groups can demonstrate their projects. First year students are specially invited to get an impression of the results of EE project course where they have to work on the next year.

4 The points of reference of the NHL teaching concept

The ten points of reference are an elaboration on the teaching concept and are described in a Dutch booklet entitled ‘Teaching concept NHL from knowledge transfer to independent learning’.

This university wide concept is based on a specific philosophy and in a way contemporary. The points of reference are launched by the Board of Governors to evaluate a course. Improvement plans have been drawn up to make the teaching concept visible in the day to day practice and University budgets have been granted for working out these plans. The ten points are defined in three sub areas;

A - active and independent learning
B - practical and job oriented
C - student directed training

Area A - active and independent learning:
Learning can be seen as an individual student process gathering knowledge and skills. The case and project approach will increase in order to stimulate the student to think and act. Working in groups in this context is considered stimulating.

I. Within the 4-year course the student is more and more in control over the teaching process.

II. The surrounding as the work space, computer and information technology and facilities are tuned for active and independent learning.

III. Time to understand, integrate and apply knowledge and skills.

For teachers and lab assistants this means a changing contribution from tutor to supervisor and facility manager in the learning process. In this way optimum learning conditions are
created. The effects on students will be an increasing control over his or her individual studying and learning process.

**Area B - practical and job oriented:**
A practical and job oriented course realizes a growing competency of the undergraduate student. This vision was caused by an increasing demand for graduates capable to cooperate, plan, organize and solve new problems. Therefore the education aims on applying knowledge, attitudes, innovative and professional skills.

IV. The out-placement is minimum 20% of the total student load.

V. The teaching program focuses on the future multidisciplinary job-practice.

The cooperation with the job-practice demands for learning material that has a multidisciplinary approach. Also the facilities, space and equipment have to be suitable.

**Area C - student directed training:**
The student directed training is a common phenomenon. In the basic assumption there is chosen for the individual student. This demands for differentiation in arrangements so there can be taken care of differences in pre-knowledge, study attitude, interest and pace.

VI. The department has an open mind for individual student characteristics.

VII. The timing of evaluations and exams have to be scheduled from a student point of view.

VIII. The department uses instruments for student feedback to evaluate teaching and courses.

IX. The department has a study-support program.

X. The school schedule is based on the activities of the student and has a balanced time spending.

All these demand a flexible teaching program, organization and an effective study-support.

5 Evaluation of the EE project course.

The evaluation of the EE project course (section 3) is guided by the ten points of reference (section 4). Results are supported by own experiences, student inquiries and interviews.

I. The student is free to select the project task and has the possibility inside a team to fulfill a specific task and concentrate on e.g. management, engineering, documentation or presentation.

II. This demands for professional and fully equipped classrooms. In the EE project situation a quite drastic improvement plan has been drawn up and is accepted to be carried out. A
documentation room with data books and extra Internet and E-mail facilities is realized recently.

III. This depends on the individual student capabilities. Experience learned that the final level of each EE project result correlates with the student ability to apply new knowledge.

IV. There is a possibility to work on an external project for an external client. But the work has to be carried out at school so the whole process can be observed.

Demanding objectives as discussed in section 3 is close to a varied job-practice. In the EE course handout a variety of these objectives are demanded to discuss in the written reports. The student can experience and experiment and will learn from this. Also the use of the 5-phase project management recipe contributes to a future multidisciplinary job-practice. The EE project starts directly after the first year at the beginning of the second year. So in theoretical knowledge there should no difference to be expected. In practical skills there is a difference. MTS-trained students have more practical skills then the HAVO-trained students have. On the other hand HAVO type students usually concentrate longer on a problem and analyze it more thoroughly. Teachers and/or supervisors have to be aware of this specific difference.

V. There is a conflict with this reference point in June when the student finishes his/her second year. Usually a lot of rounding-up as exams and lab-reports needs to be done besides finishing the EE project. This is not ideal but experiencing deadlines and even suffering stress has it’s learning effect on students.

VI. A great value is attached to student feedback in our department. Strengths and weaknesses are discussed during and after completing the project. All students are inquired with a general questionnaire at the end of each year in June and with a more specific questionnaire to judge the EE project course. The outcomes are handled seriously.

VII. Each student is free and stimulated to ‘walk in’ when there are problems or draw-backs in his/her project. Depending on the problem the student will be supported individually.

VIII. This point has similarities with reference point VII and depends on the week and year school schedule. But pressure on students in the end of the year especially in the EE project course will stay a insurmountable problem.

IX. Each student is free and stimulated to ‘walk in’ when there are problems or setbacks in there project. Depending on the problem the student will be individual supported.

X. This point has similarities with reference point VII and depends on the weekly school schedule and year schedule. But pressure on students in the end of the year especially in the EE project course will stay a insurmountable problem.

It is clear that not all the specific EE project recognizable points have relationship with one of the ten points of reference.
6 Conclusions.

To guide the students in their project and to achieve a universal approach a 5-phase project management prescription was introduced. This prescription is widely accepted among students and teaching staff in the department and resulted in noticeable more organization and management skills.

In spite of the University’s wide teaching concept is based on a specific philosophy and in a way is contemporary it was an useful instrument to evaluate the EE project course. The evaluation has resulted in a plan to improve the lab which is accepted to be carried out. Through a more professional and job-reflected approach student motivation and enthusiasm has increased. This increase resulted in a higher technical level of the projects.

7 Bibliographic information.

1 Board of Governors: ‘Onderwijsconcept NHL van kennis overdragen naar zelfstandig leren’, booklet, NHL, 1996.

8 Bibliographical information.

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