

Promotion of Talented Students in Engineering Education

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With this contribution the author would like to participate in the international discussion on the most effective approaches for the promotion of specially talented students. However, it should always be taken into account that there are no formulas available, no dogmas apply, because each process of promotion is a creative process even in terms of finding objects and methods, which places high demands on both parties involved, with the university lecturer taking responsibility.

THE promotion of special talents today results from striving for and achieving such performances that will have a faster and greater economic effect within international competition. At the same time, it is a result of the humanistic principle to develop the creative abilities and talents of man.

According to our understanding, special talent is a system of individual dispositions enabling multiple high performances in one or several disciplines provided the required conditions are given. Substantial components are:

1. Outstanding general abilities and knowledge.
2. Comprehensive talent-specific abilities and skills.
3. High level of talent promoting goal orientation.
4. Considerable self-confidence and endeavour towards self-realization.

Based on experience collected at the Dresden University of Technology in terms of the promotion of specially gifted engineering students five statements will be offered for discussion:

1. Engineering education at university is basically promotion of talents related to age groups and should therefore be organized accordingly. We quote this in contrast to the internationally discussed alternative of mass or top promotion: without a broad raising of the general level the top level of individuals will not become efficient enough. Talent for the profession of engineering is required first of all in engineering activities. Thus, engineering activities have to become the content of engineering education as early as possible.
2. From the very beginning of their studies the students should be given opportunities to 'find themselves', to recognize their strong points. Particularly, they should be encouraged to offer special performances and to apply themselves for special promotion. With regard to the

engineer profile the recognition of special talents should not merely be reduced to theoretically and/or experimentally cognitive activities (goal model: discoverer), but rather reflect the model's inventor, manager/organizer, methods engineer.

3. When a special talent is discovered the general curriculum can be adapted in order to promote the talent. However, as well as flexibility, two principles have to be enforced consistently: goal orientation and continuity. Guidance for the promoted student is a central task for the purpose of 'self-goal acquisition', since the motivation for action will be more and more displaced from the external to the internal sphere and imposed or given problems lose their dominant position.
4. Successful promotion of talents will always be bound to personally related guidance by experienced scientists. Promotion must not be restricted to setting and evaluating tasks. Much will depend on personal contact with scientists within the process of task solving. And we should not forget that talent does not only involve learning, but also learning involves talent.
5. Each promotion process will only be completed after an evaluation and transfer of the promotion results. Two peculiarities compared with other students become evident in the evaluation of performances of specially gifted students.
 - a. Self-evaluation plays a comparatively greater part than evaluation by other people.
 - b. Idealistic appreciation is considered more valuable than financial appreciation.

Finally, the university has to take care of the social and individual usefulness of its 'specially promoted students/candidates'.

On the basis of these and continuing thoughts a series of projects for the promotion of young scientists for universities and industry was introduced at the Dresden University of Technology. They are all under the protectorate of the rector. In

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addition to scientific contests and conferences of students, studies with defined targets, special promotion in *master classes*, as they are called, has developed in an interesting way in the last few years. They will briefly be characterized in the following.

Training in master classes has been performed in the fields of computer sciences, electronics and production automation science since the spring term of 1988. The basic idea consists of using the concentration of relatively modern equipment and devices, and the most efficient scientists, for the promotion of highly talented students of engineering.

The principle goal in master classes is to provide free scope for individual organization of studies under the personal guidance of a university lecturer and thus to develop top scientists for supervising students and for industry.

As a rule, master classes are formed in the fourth term. Students apply for admission. Conditions for this are:

- outstanding performances in studies
- intelligence quotient (equal to or over 120);
- references from industry and university;
- personal demand on performances, expressed by self-formulated targets of performances.

Currently, there are about 100 students receiving such training. This comprises 0.6% of all students of the Dresden University of Technology.

Each master student follows an individual programme of studies, which he has worked out with his tutor. This programme includes the following statements:

- envisaged activity after studies;
- courses to be attended and examinations;
- content, form and report of research work.

Its fulfilment is the condition for an additional performance grant of 150 DM/month.

Concerning individual free scope, the general

curriculum is reduced for a master student to a third of the total of usual training programmes, thus providing two-thirds of the overall training for individual studies and research work for the master student. This free scope in individual curricula is usually occupied by selected courses for one half and by participation of the master student in research work for the other half. A master class is a deliberately loose form of organization. It is important that the free scope provided is not immediately reduced by alternative regulations. There is a greater demand for common courses, comparisons etc., such as:

- common discussions on the effect of master classes, with university lecturers;
- scientific symposia for the presentation of research achievements;
- excursions;
- creativity training;
- common attendance of academic events.

Industry is showing growing interest in master students, especially as graduates. However, the participation of industry in their training is considered much more important, e.g. by making industrial grants available.

If the present results of the current situation in master classes are evaluated at least two aspects should be taken into consideration:

1. The master classes take place under the special conditions of the Dresden University of Technology. In spite of high ambitions there is an economic and social background opposing the effectivity of projects (situation in students hostels, computer capacities, workplaces, opening times), which will not be overcome sufficiently in the near future.
2. New ground has been broken in Germany with the project of master classes, therefore there are no examples to follow. All difficulties have to be solved by the current project team.

Personal qualities