INTERNATIONAL ENGINEERING AND PRODUCT DESIGN EDUCATION CONFERENCE
2-3 SEPTEMBER 2004 DELFT THE NETHERLANDS

SKILLING ENGINEERING STUDENTS SOFTLY: A REVIEW ON THE EDUCATION PROGRAM "TUTORENSYSTEM GARCHING"

G. C. Baumberger and U. Lindemann

ABSTRACT
The paper introduces and reviews a soft skills education program at the faculty of mechanical engineering at Technische Universitaet Muenchen. The main objective of this "Tutorensystem Garching" is to supplement technical education in engineering science with social skills. The contribution gives an overview on content, organisation, and teaching methodologies of that education program and takes a detailed stock of the recent years.

Keywords: interdisciplinary engineering education, soft skills, new teaching methods

1 STARTING SITUATION

In 1995 students, staff, professors, and head of mechanical engineering faculty at Technische Universitaet Muenchen (Munich) came together to discuss new approaches to improve quality and efficiency of engineering education at the university. Dramatically decreasing school enrolments in technical courses (partly over 60%) and an increasing number of drop outs at the same time were the main indications that measures had been necessary. Furthermore industrial enterprises complained about lacking methodical and social qualification of graduates. In fact graduates were well-trained in technical knowledge but they missed important professional competences such as communication ability, creativity, self assurance, and self-reliance. When starting to work these graduates faced a lot of problems concerning the promotion of own ideas, setting and achieving personal goals, as well as working in teams. Beyond they needed a long time of vocational adjustment.
General problems in university education such as mass lectures (impeding the establishment of social networks), questionable teaching methods, missing practical orientation, lacking application of knowledge, and insufficient support in study matters led to this situation. Thus the objective was to find appropriate measures to improve the described situation.
Based on the principle of the English and American college system (that, contrary to current discussions, cannot be applied to the German university system without further ado) a program was conceived, where elder students take care of first year students, not as a supervisor but as a contact person and a tutor in working methods and social skills. That's why the program was called "TUTOR – Tutorensystem Garching". The concept builds up on the following principles

- A 3rd or 4th year student („tutor") coaches a group of 10-12 first year students in weekly meetings.
- He gives advice in study matters (curriculum planning, necessary lectures and

examinations, etc.) and helps with orientation at university.

- Besides, social and communicative skills will be trained by means of practical exercises.
- The background of these skills (e.g. basics of team work, presentation methods, etc.) shall be extensively worked out by the students themselves – the tutor does not present any theoretical knowledge but instructs the exercises and gives feedback. The underlying principle is that grasping and practicing of knowledge is much more sustainable than only listening or reading.
- Finally the "Tutorensystem Garching" is a unique feature of the Munich engineering school. It shall promote excellent students. That's why application is necessary and only qualified students are allowed to take part. Still, participation is voluntary.

The described concept was realised and launched during the winter semester of 1996 with 10 groups. After a very successful first run the number of groups was raised to 20 to give more students the possibility to participate in the program where they learn skills that go far beyond the usual curriculum of German engineering schools. Until now, over 1600 students and 137 tutors have participated in the program [1].

2 CONCEPT OF "TUTORENSYSTEM GARCHING"

Below the concept of the "Tutorensystem Garching" shall be described in more detail. The content of weekly group lessons as well as the underlying teaching methods will be considered especially.

2.1 Curriculum

The primary object of "Tutorensystem Garching" is the promotion and propagation of social skills as an important additional part of engineering education. That way, technical and academic skills will be complemented with elementary vocational abilities [4]. Important soft skills, which are treated, include

- Team working capability,
- Leadership skills and conflict resolution,
- Communication skills,
- Presentation and moderation techniques,
- Personal time management skills
- Self perception and performance
- Study techniques and stress/problem solving
- Creativity methods, and
- Project management.

In more, detail training in team working skills includes successful dealing with group dynamics and team development stages as well as different team roles. Necessary basic conditions and approaches of successful team work are treated as well.

Leadership training refers to common leading roles and models and introduces the principles of situational behaviour, target agreement, and handling of conflicts.

Communication training contains active listening and conversation, question techniques, feedback and the appropriate handling of differences in perception and interpretation on several communication levels.

Presentation and moderation training is covering visualisation and demonstration techniques as well as approaches for successfully conducting a discussion. Moreover, different lecturing styles and basic characteristics of a good presentation are discussed.

Personal time management skills comprehend time planning and scheduling. In addition time saving principles are introduced, e.g. appropriate assignment of priorities and delegation. This topic is topped of by methods to increase personal efficiency by setting and realising individual goals.
Study techniques comprise methods of learning, reading, and memorising, such as connotation and repetition techniques. Typical training curves, methods of information gathering and structuring, as well as advices for efficient studying (in respect of workplace design, diet, breaks, and recreation) are presented. Furthermore strategies of calming down and relaxing as well as ways of solving mental blockades are introduced.
Creativity techniques include notions of inventive processes, creative environments, and problem solving methods, e.g. Brainstorming, Method 6-3-5, and Synectics.
Finally presented project management skills refer to project organisation, scheduling, management of resources and project controlling.
Besides, guidance shall be given and assistance at study planning provided, especially at the beginning of the first semester. Tours to different chairs at the faculty and a series of lectures by experienced engineers from the practise shall help to give a notion about the future career. Last but not least socialising and networking is another important aspect of the "Tutorensystem Garching" – common leisure activities or cultural life help to create a close community that persist far beyond graduation [5].

2.2 Teaching methodology

The basic learning philosophy of "Tutorensystem Garching" is not to teach the students but to encourage them to work out and practice related issues on their own. That shall help them to internalise the underlying principles of the discussed social skills as much as possible.
The student group and their tutor get together in weekly meetings. Here, the student group jointly carries out short case studies and discusses related topics, such as problems at team work, possible causes and approaches for solution (Figure 1). The tutor is responsible for instruction and moderation [3, 6].

Figure 1. Typical situations in weekly Tutor meetings

An applied teaching methodology to support this approach is the Theme-Centred Interaction (TCI). This method specifies a group concept that aims at active, creative, explorative ("vivid") learning and working. Within this concept the knowledge transfer shall be vitalised by integration of the involved people and their relationships. At this, patterns of the group process will be utilised to create a dynamic balance between the different individual needs ("I"), the interaction of the group ("We") and the topic/task, taking the environment ("Globe") into consideration as well (Figure 2). This way, the success of each individual, the togetherness of the team, and the problem solving process shall be promoted similarly [2, 7].

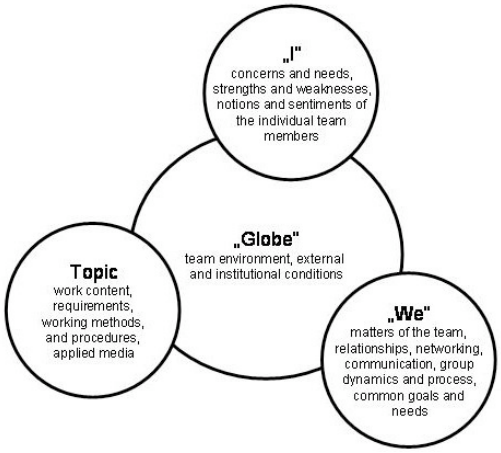

Figure 2. Model concept of Theme-Centred Interaction

Depending on the specific topic, the tutor lessons are characterised by brainstorming discussions, presentations by students or tutor, group or individual work, short exercises, games, or case examples followed by exchange of experiences, etc. Outdoor activities are quite typically as well, e.g. exercises such as the bridge construction or the blind rope square to demonstrate group processes and team working principle (Figure 3), [3].

Figure 3. Outdoor tasks as part of the Tutor education

Main objective of the described approach is rather to sensitise the students in soft skill issues than to submit a complete code of "social practicing".
To get even more practice the students run a little project during the second semester. Each group chooses the subject of the project itself. Afterwards they have 3 months for

planning and realisation – of course by applying the acquired skills and methods in presentation, project management, problem solving etc. Examples from recent years include the organisation/participation of/at the annual engineering faculty design contest, a soap box derby, and a screen record about "TUTOR".

2.3 Tutor education

Apparently, the tutors themselves are an integral part of the program. They are the core and responsible for quality and appearance. The tutors will selected among especially capable and dedicated 3rd or 4th year students after application. The tutors undertake the task for a period of one year – thereafter a new generation of tutors will be assigned. The tutors receive very intensive preparatory instruction in the required skills by professional trainers. This training is very similar to the future group training but it is more intense during weekend workshops. Additionally they get deep instructions in leadership skills, class scheduling, as well as very close feedback on their proficiency and improvement opportunities by the trainers. Accompanying, they get organisational support and feedback/coaching during the semester. By transferring/applying the required skills during the group meetings and because of the very intensive feedback, the tutors have an immense learning effect what makes this program attractive for senior students.

3 REVIEW

In the following section the benefits, results (so far remarkable) as well as existing problems shall be pointed out.

3.1 Evaluation

In 2003 a comprehensive survey was carried out among participating first year students, present and former tutors to get an impression of the actual benefit of the program.
Participating students were asked how they estimate the usefulness of the treated topics (Figure 4), i.e. which topics they regard as very or less interesting.

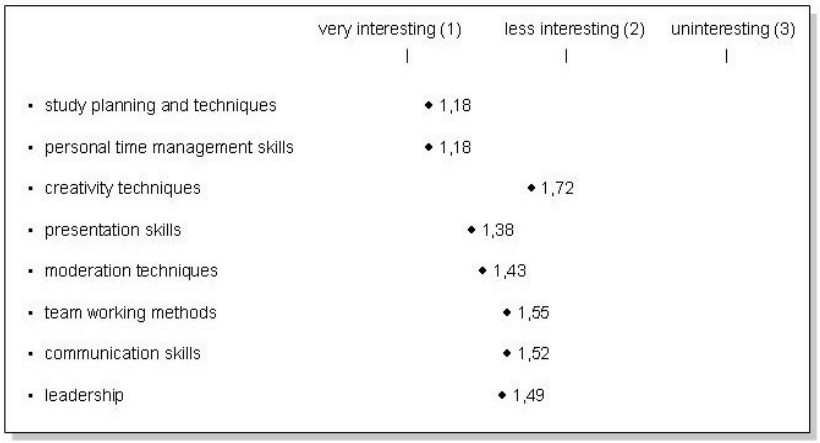

Figure 4. Results of the evaluation among students: Usefulness of the methods

As for the topics, team working methods, study techniques, and time management skills were rated as most important while communication skills and creativity techniques play an underpart.

Asked for the benefit of "TUTOR", they indicated as most important to get to know new people (keyword: *socialising*), to get useful hints concerning study matters, as well as to have fun at all (Figure 5). The commitment of the tutors, common private activities, and the forming of a real team are emphasised as especially positive features.

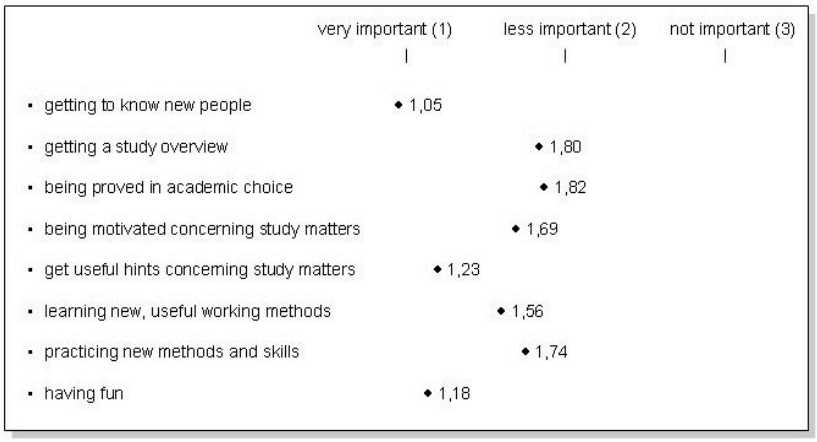

Figure 5. Results of the evaluation among students: Benefit of participation at Tutor

Altogether 80% of attending first year students would recommend "TUTOR" to new students and still 30% are interested in becoming a tutor oneself. On the other hand, only 60% think that "TUTOR" is useful for university and working life. Likewise, a high percentage of the students complain about the time spent (ca. 2 hours/week) which is obviously too much in their perception compared to the benefit. Here it has to be considered that the curriculum during the first semesters is already much filled.
As for the present tutors, the benefit of "TUTOR" is estimated much higher compared to the students (as expected). On a range from 1 to 5 "personal benefit" is ranked 1, 26. This can be explained with more intensive training as well as deeper integration.
The results of the survey among former tutor were expected with interest because they might permit a more reliable statement on the actual benefit of "TUTOR". That's why the positive/negative effects on studying and starting to work successfully were regarded especially (Figure 6).

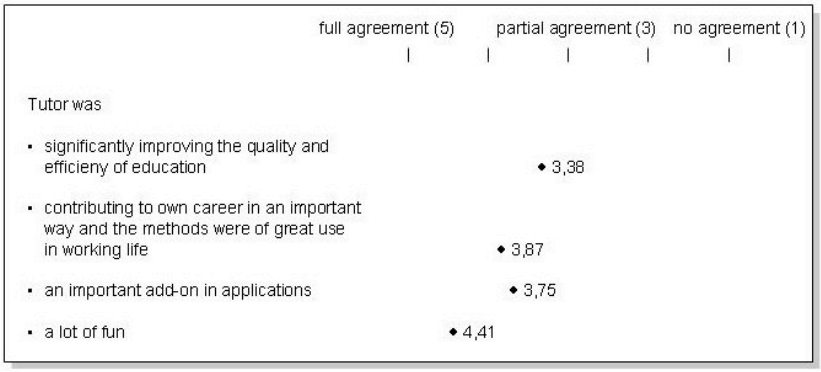

Figure 6. Results of the evaluation among ex-tutors: Benefit of participation at Tutor

Over 50% of attendants stated, that “TUTOR” had improved quality and efficiency of studying considerably (average 3, 38 on a range from “1: does not apply” to “5: applies entirely). Almost 70% stated that “TUTOR” was an important contribution to the career and that the learned methods have been of great use in working life (average 3, 87). 50% regard participation and connected qualification as an important add-on in applications (3, 75). Many of the attending tutors especially estimated the formed network and socialising capabilities as extraordinarily important for working life. And still 90% emphasise the fun, they had (4, 41).
To sum it up, it can be said that in generally participation at “TUTOR” is regarded as a very positive experience. The acquired skills are of great benefit for studying and working. Little group size, presented methods and skills, and the relationship between tutor and students are esteemed as outstanding features here. By the way, this result reflects a balanced proportion according to TCI model as well.

3.2 Existing Problems

Despite of the generally positive evaluation some problems yet have to be faced. E.g. the number of applications with only 50% of the fresh students is still to low. This indicates a basically low interest in soft skills and little knowledge of their professional importance. It is a fact, that there is no capacity to admit more students but a larger range of applying students would result in a higher quality of the attending at all. This leads to the next problem of stabile group size. Usually a decline in the number of participating students can be noticed during the two semesters (last year about 20%). This can be explained with growing demands of the normal curriculum. Because of that, priorities move and many students are not willing to spend even more time at university with an additional, voluntary subject. Paradoxically, these students do not question the usefulness of “TUTOR”, which just shall improve the efficiency of study techniques and time management skills! This connection is obviously not noticed. Both little applications and decline in group size indicate that “marketing” referring to the benefit of “TUTOR” have to be improved. This might be realised by intensified integration of ex-tutors and industrial partners.
Analogous, the number of applying tutor students is not satisfying (25 applications for a vacancy of 20 last year), since more applications lead to an improved capability of the tutors at all. The special benefit and the unique qualification have to be emphasised in a stronger way at this to improve this situation.
Finally, financing is increasingly difficult: In view of omnipresent cuts funds for such social projects are not supported anymore and increasingly spend for more necessary issues. At this, overall cost-reducing effects have to be emphasised more clearly, e.g. through reduced studying times or better qualification of graduates which also improve the reputation of the university. Likewise the university can point out the “TUTOR” program as a unique educational feature that might attract more or better students. Last but not least companies might be challenged more concerning sponsorship since they profit by a good qualification of graduates to a great extend. Yet, all this claims have to be verified by long-term studies on the effects of “TUTOR” to convince potential supporters.

4 CONCLUSIONS

In the paper at hand the education program “TUTOR – Tutorensystem Garching” at faculty of mechanical engineering at Technische Universitaet Muenchen was introduced. By this program social skills are promoted and capabilities shall be imparted

that substantially supplement conventional engineering education as refers to vocational practise. The presented skills are demanded by enterprises and human resource experts again and again and they help students and graduates by coping with manifold academic and vocational requirements. “TUTOR” helps first-year students to find into their studies, to socialise with fellow students and to get help and orientation from senior students. This also helps to avoid anonymity at university. For tutors acquired and thoroughly practised skills and experiences at team leadership are the main points. Both tutors and students commend the way of thinking “out of the box”.
With the “Tutorensystem Garching” the Munich engineering faculty has created an education format that is unique in Germany, and is contributing significantly to an improved engineering education. That strengthens the position and the reputation of the university and makes it more attractive for students. Last but not least engineering graduates from Munich might show a better performance on starting a job. That finally makes them more attractive for potential employers as well.

ACKNOWLEDGEMENTS:
“Tutorensystem Garching” is an education program by Technische Universitaet Muenchen and Faculty of Engineering, Munich. It is conducted by the department of product development (Prof. U. Lindemann). In the name of the participating students and staff we want to thank for their support over the recent years. For further information see www.tutor.mw.tum.de.

REFERENCES

[1] Baumberger, C., Leitschuh, T., Mauser, P., Schneider, S., “Tutorensystem fest etabliert”, TUM Mitteilungen 1 – 03/04 (2003), pg. 31-32.
[2] Cohn, R.C., Von der Psychoanalyse zur themenzentrierten Interaktion, Klett-Cotta, Stuttgart, 1997.
[3] Knauf, H., Schmithals, F. (ed.), “Tutorenhandbuch – Einführung in die Tutorenarbeit”, Luchterhand, Bielefeld, 2000.
[4] Landau, K. (ed.), “Arbeitstechniken für Studierende der Ingenieurwissenschaften”, Ergonomia, Stuttgart, 2002.
[5] Passarge, G., “Studenten erwerben soziale Kompetenz”, Süddeutsche Zeitung, 31.08. 2003, pg. R1, R3.
[6] Tschan, F., Produktivität in Kleingruppen Was machen produktive Gruppen anders und besser?, Huber, Bern, 2000.
[7] Ruth-Cohn-Institut für TZI International, Portal für Themen zentrierte Interaktion, http://www.tzi.info/info/index.html, 30.03. 2004.

Contact Information:
Georg Christoph Baumberger,
Produktentwicklung,
Technische Universitaet Muenchen,
Boltzmannstrasse 15,
85748 Garching,
Germany.
Tel: +49 89 289 15150
Email: baumberger@pe.mw.tum.de
URL: www.pe.mw.tum.de

Co-author Information:
Professor Dr Udo Lindemann,
Produktentwicklung,
Technische Universitaet Muenchen,