QUALITY ENGINEERING TEACHING FOR QUALITY ENGINEERING LEARNING

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Abstract
The aim of our current survey was to make the outcomes of an analysis of student essays available to engineering teachers and faculty management. Engineering students of Czech Technical University in Prague submitted their opinions and experience in a 500-1000 word essay “What makes a good engineering teacher”. Results of this survey were compared with a similar one conducted 9 years ago.

Keywords: Teaching quality, essay analysis, qualitative methodology, teacher expertise, human qualities, didactic qualities.

1 INTRODUCTION
The higher education (HE) teacher’s personality is a deciding factor of the quality of the educational process (Biggs, 2003, Mareš, 2013, Holeček, 2014). Experts in various sciences, such as theory of education, educational psychology, philosophy and sociology of instruction have tried to analyze this issue. Different approaches have been used: deduction – when scientists described an “ideal” teacher (various lists of appropriate teacher competences), induction - when students evaluated their class teachers, or when psychological tests backed the illustration of real qualities of teachers. Sometimes, a combination of both approaches seemed appropriate (Koetsier et al., 1996).

Other authors offered lists of personality attributes – principles of effective teaching in higher education. Ramsden (2003) suggested 6 key principles:
- interest and explanation
- respect for students and student learning
- appropriate assessment and feedback
- clear goals and intellectual challenge
- independence, control (by students over their own learning) and engagement
- learning from students

Other lists of desirable qualities of HE teachers are available from public bodies involved in professional recognition and accreditation. The UK Higher Education Academy (2010) defined these qualities partly in terms of core knowledge. Applicants via the individual entry route were expected to demonstrate knowledge of:
- the subject material that they will be teaching
- appropriate methods for teaching and learning in the subject area and at the level of the academic programme
- models of how students learn, both generically and in their subject
- the use of learning technologies appropriate to the context in which they teach
- methods for monitoring and evaluating their own teaching
- implication of quality assurance for practice.

2 METHODOLOGY
The method of a qualitative analysis was used in our surveys. The engineering students were asked to write a 500-1000 word essay where they expressed their opinions on characteristics of a good HE teacher. Although the form of student essay has not had such a long tradition at Czech universities compared to the English speaking countries, we decided to replace regular student questionnaires.
We knew students disliked to fill in questionnaires for research purposes, sometimes for unclear reasons. Methodologically, we had found our inspiration in essay analyses as performed by Davies (2006) who had used this methodology at the University of Coventry.

The main attributes of a good engineering teacher were derived after 3 phases of qualitative evaluation. After all relevant semantic formations were registered and assorted and the synonyms were set aside, all the characteristics were included into 3 categories: teacher expertise, human qualities and didactic and presentation qualities. The level of consensus was expressed as: strong consensus - referred to in virtually all the essays, good consensus – referred to in more than half essays and some consensus – referred in several of the shortlisted essays.

3 RESULTS

3.1 Survey I (2007)

Some research activities aimed at the description of technical teacher personality had been already undertaken at the Czech Technical University in Prague in past in order to put more light into student motivation to study engineering programmes (Dobrovská, 1995, Šafránková, 2005). Other information on teaching quality had been available to teachers from student questionnaire reports every semester. The aim of our 2007 survey was to make the outcomes of another student report to engineering lecturers and faculty management.

Our research sample - students of the Master engineering programme (84 students, age 22 - 26, 1/3 from these were female) submitted their opinions and experience in a 500 -1000 word essay “What makes a good engineering teacher”. Perhaps as a result of word association, the word teacher in the title seems to have led the essay writers to concentrate on the role of lecturers and some more forms of class, generally a practical class, laboratory class, project tutor, etc. However, the students referred to the relationship between the teacher and the students’ own learning.

The main attributes of a good engineering teacher were derived after 3 phases of qualitative evaluation (as performed by Davies). In the first phase all relevant semantic formations in essays were registered and assorted (substantives, adjectives and verbs). In the second phase synonyms were set aside and all the attributes were included in 3 categories:

− expertise of teachers
− human qualities of teachers
− didactic and presentation qualities of teachers

In the last phase quantification of answers and final classification of data was completed.

3.1.1 Expertise

A major consensus of students referred to expertise. A good engineering teacher has depth of knowledge and command of the material, he/she keeps proper knowledge up-to-date and uses real-world engineering examples backed up by practical experience. One student wrote: “…it is all too easy to spot a teacher who has spent his whole life in education and merely conveys the bones of the subject matter without the flesh that real life would provide.” The importance given to real-world examples and practical experience was significant because some professional engineering institutions are currently expressing concern over the declining numbers of new engineering lecturers with practical experience, caused by the pressure to appoint staff on the basis of research record. Surprisingly, engineering students also mentioned a technical university teacher should have a good general education.

3.1.2 Human qualities

The student list of human qualities was rather long, even after a considerable semantic reduction: a teacher should be friendly, open-minded, communicative, tolerant, available and enthusiastic (the last component makes a teacher impressive and charismatic). Students criticized a teacher who only presents slides, without any interest in the audience, a good teacher should possess awareness and responsiveness to the students’ needs and should interact with students as individuals. The teacher should also be human, objective, fair-minded and honest. Among conative characteristics exactness, conscientiousness, patience, orderliness, responsibility and consistency were often mentioned. Most
of the students who referred to these attributes did so in the context of seeking help with the subject. The teacher should be young in spirit and should be able to admit errors (his/her ego should not be overdimensioned). His/her appearance should be tidy (!). Students also appreciated the teacher’s sense of humour.

3.1.3 Didactic and presentation qualities

The students suggested a good engineering teacher should give sophisticated presentations. He/she should be a good speaker and speak with clarity, lectures should be well structured. Teachers should have a good knowledge of literary language (critique of poor Czech grammar, vocabulary and low semantic sensitivity is frequent… “some CTU teachers should be sent to an obligatory 2 semester course of the Czech language…”).

If he/she can persuade an audience that the material is worthwhile and important then the listeners may well be inspired to improve the world around themselves with innovative and inspirational solutions. This needs for an excellent knack, for example and analogy, a feel for how the concept looks to a student who does not yet understand it and an instinct for how well the audience understood the last sentence spoken. A method of explanation that was instantly successful last year may only confuse this year’s batch. These are clearly important and difficult skills. A good teacher is a great motivational tool for students; he/she should be creative and master a variety of adequate methods.

The students did not only describe the desirable qualities of good engineering teachers, but they were also thinking back on good teachers they met during their secondary school studies. “Good teachers are always fondly remembered and consequently the solid foundation that the students build with the help of the teacher is something that lasts for life”. Another consideration … “a good teacher is one whose classes I am able to recall in years to come, not only when it comes to exams…”

3.2 Survey II (2016)

Similar methodology was used in a group of mature-age students (62 distance students, age 30-46, ¼ female, students of Bachelor programme “practical classes teaching”). Again, 3 phases of evaluation were used: all relevant semantic formations in essays were assorted, synonyms were set aside and all the attributes were included in 3 categories: expertise of teachers, human qualities of teachers and didactic qualities of teachers.

3.2.1 Expertise

Similarly to previous survey, students expected good teachers to master their subject and give positive messages to students which are essential for motivation. “The most important quality engineering lecturers can have is to be genuinely interested in the subject that they teach”. […] “Enthusiasm is contagious and it encourages the student into further study of the subject, which in turn makes subsequent topics easier to understand” “the teacher is a knowing guide to the wanderer”.

A teacher is able to impart technical knowledge and to foster the development of technical skills, should be able to manage rapidly growing knowledge base.

A well organized and suitably prepared lecturer is one likely to make a good impression on several respondents. “Preparation is vital to gain student confidence in their knowledge and the information they provide – no one likes to wait for a lecturer to work out his own slides”.

3.2.2 Human qualities

Again, the student list of human qualities was rather long, even after a considerable semantic reduction. Two qualities which were mentioned in most essays were teaching enthusiasm and caring attitude toward students. The need for caring attitude was perceived as essential as many mature-age students were afraid of possible study failure due to long time lapse from high school study. Other qualities were similar to the ones which were described in previous research.

3.2.3 Didactic and presentation qualities

Text-books, notes and handouts provided by the lecturer rated very highly in the entrants’ list of priorities, some favouring the fill in the gaps kind as a way of ensuring attendance at lectures, but all in agreement that clarity and quality are of the utmost importance.
Communication skills were also of vital importance to our essayists. The standards expected by them were high (and rightly so), as they did not just consider lecturing to be a one-way street. Interacting with the class, or audience participation was cited in 26% of the essays as crucial to the success of the learning experience. A similar number of essays cited clarity of course structure as key to a lecturer's success.

3.3 Comparison - Survey I and Survey II

It was not considered appropriate to give precise percentages based on relatively low number of essays, and so the level of consensus was expressed as:

- strong consensus - referred to in virtually all the essays
- good consensus – referred to in more than half essays
- some consensus – referred in several of the shortlisted essays.

Categorisation of attributes in both surveys:

Strong consensus – virtually all the essays referred to these characteristics:

- that a good engineering lecturer: is enthusiastic, gives clear, well-structured presentations use real-world engineering examples backed up by industrial experience.

Good consensus

- the following characteristics were clearly identified in more than half of the shortlisted essays: a good lecturer has a genuine interest in students as individuals and as members of an audience (is friendly, approachable and patient; is audience-aware and responds to the student feedbacks), he/she encourages learning, has depth of knowledge and command of the material, uses visual material and demonstrations effectively.

Some consensus

- In addition to these characteristics, several essays indicated that a good engineering lecturer is good at simplifying difficult concepts and is well organized and reliable.

4 CONCLUSIONS

Similar results were received in survey I (2007) and survey II (2016) after essay analyses of two cohorts of students - despite of the lapse of time and differences in age and study experience (undergraduates, age 22-26 in 2007, distance students, age 30-46 in 2016). Students presumed high expertise of their teachers, but also underlined importance of the real-world engineering examples. Enthusiasm and ability to motivate were perceived as essential. In second survey, the mature-age students indicated teacher support at the utmost importance.

REFERENCES


