



# Methods of motivating students to learn at technical mechanics classes

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## ABSTRACT

**Purpose:** The paper aims at presenting different methods of motivating students to learn during technical mechanics classes.

**Design/methodology/approach:** It was assumed that adding variety to the grading system would enhance students' interest in technical mechanics classes. Exercises on the board were supplemented with simple experiments, in the preparation of which participated students themselves. The method of preparing the experiments and the way their presentation were evaluated by an academic teacher. Such evaluation was complementary to the traditional method of checking students' knowledge in the form of written tests.

**Findings:** After the classes finished, an anonymous survey was carried out among the students. The students appreciated a varied grading system as well as the additional experiments. Also, an attempt was made to evaluate the influence of modifications in conducting the classes on the marks the students received.

**Research limitations/implications:** Motivating is a complex system of influence, composed of a number of factors. The teacher is able to directly influence only some of them. This paper presents only those system factors which depend on the teacher. Nevertheless, they are examined within the entire complex of other determinants influencing the learning process.

**Practical implications:** The grading system described in the paper led to enhancing students' interest in the subject in which it was applied.

**Originality/value:** A transparent and expanded system of evaluating students increases their involvement during classes. Since every person has different skills, predisposition and previously acquired knowledge, such system allows getting through to more students while trying to improve their learning results.

**Keywords:** Education; Students; Motivation; Teaching process

## EDUCATION AND RESEARCH TRENDS IN MATERIALS SCIENCE AND ENGINEERING

### 1. Introduction

The teaching process is influenced by a number of factors. These include, inter alia, the premises and equipment, appropriate remuneration for lecturers, scholarship system for the best students as well as kind relations between the academic teacher and the student. We are not able to influence all these factors. The financial situation of state universities and colleges results in the fact that we do not always have the newest laboratory equipment

at our disposal. Certainly, this fact is easily noticed by students and in some cases may cause their reduced motivation to learn. Therefore, it is vital to focus on the remaining factors, which determine the quality of the teaching process [1-14].

Students' grades are strongly connected with the factors determining the students' motivation to learn. Students who are encouraged to acquire knowledge will have better learning results and in the future, they will be able to become better specialists. Motivating is based on influencing students by the lecturer whether in a material or non-material way, in order to increase

their will to learn. A decisive role in the motivating process is played by the academic. Whether students will be willing to broaden their knowledge or to reduce the learning to the essential minimum, depends on the intuition, observation abilities and personality features of the teacher.

For the efforts of the academic to be fruitful, it is necessary that he/she focuses on students' strengths, without reproaching the students for their weaknesses. Also, the academic must establish the excellence standards at an appropriately high level and create such an atmosphere, where students are not afraid to learn from their mistakes. The attitude of the academic towards his/her work is of great importance here. Students are able to sense intuitively if the teacher cares to arouse their interest in learning or just conducts classes without being too much committed.

Frequently, the system which brought very positive effects in one group does not necessarily perform well in another group. That is why it is very important that the teacher should continuously improve and broaden his/her knowledge about the methods of motivating [1, 3, 6, 7]. An appropriate system of motivating students determines the quality of the teaching process. Its application during classes results in the fact, that it is not only students that feel satisfaction, but also the teacher him/herself, and future graduates become more competent.

## 2. Factors influencing motivational effectiveness

Effectiveness of the motivational process is measured by means of the execution of assignments given by the motivating person and, on the other hand, by the level of satisfaction and contentment of the motivated one. A number of factors influence this process (Fig. 1).

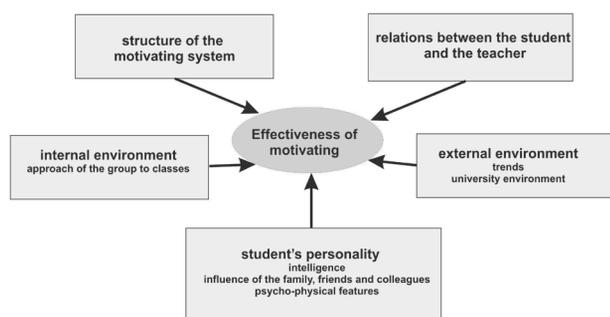


Fig. 1. Factors influencing the effectiveness of motivating (author's own study based on [16-19])

External motivation consists in control of the motivated person's actions. A person so stimulated to work feels that the control of his/her actions is of an external nature and he/she is not dependent on the control, which may lead to discouragement. In the case of internal motivation, the motivated person is convinced of her/his influence on the method of acquiring the knowledge. Such person is interested in the subject of the class and her/his interest results from curiosity.

## 3. Method of conducting classes in technical mechanics

Exercises in technical mechanics are commonly believed by students to be difficult. Conducting them in an attractive form, that would encourage students to learn, is often a difficult task. This results, among other things, from the nature of the subject, which includes theoretical fundamentals requiring previous thorough preparation in the field of mathematics and physics. Studying mechanics is also based to a large extent on solving problems on one's own, where the problems consist of particular tasks. The necessity to possess previously reinforced knowledge is one of stressing factors. In addition, during classes in mechanics, students frequently encounter problems, the solution of which requires a certain dose of experience. Motivation to studying the subject, which can be influenced by attractiveness of the method of conducting the classes, is an important factor essential for gaining such experience. In order to increase motivation among students, the classes in technical mechanics were conducted using a developed grading system. Students wrote short tests in the scope of the material covered during previous class. Their activeness was awarded. They received additional partial marks in the form of "pluses" for solving a problem on the board. Additionally, the students could obtain a plus for experiments made during the class, for which they had prepared at home. They received an explanation regarding the method of conducting the experiment from the academic teacher. One of them concerned the notion of the centre of gravity, which was presented using the example of systems composed of different elements [19], and the other one was supposed to make students aware of the importance of friction force [20].

In the first case, the experiment was conducted as follows:

In a wooden board, 25 cm long and 15 cm wide, a hole was cut out at a height of  $\frac{2}{3}$  of the longer side. Next, the shorter side of the board was cut at a  $60^\circ$  angle and a bottleneck, with the bottle partly filled with water, was put in the board, as shown in photograph [19]. The balance of the system depends on the amount of water filling the bottle.

In the second experiment, we fill the bottle with rice, leaving empty space at the top – the best is a few cm. We push in a long pencil through the bottleneck and next, we try to take it out. After a few attempts, the position of the pencil will be determined and the friction between rice grains and the pencil will be so high that it will be possible to raise the bottle while holding the pencil [20].

A number of other experiment in dynamics and kinematics was carried as well. For example, an experiment depicting the notion of the centre of instantaneous rotation, or the principle of conservation of energy.

During the classes supplemented by such simple experiments, an increasing interest was observed among the students.

Persons who conducted the experiments were taking on the role of the teacher. They showed the experiment and encouraged their colleagues to carry it out. They were giving advice and correcting mistakes. They used their previously acquired experience.

It was necessary to encourage students to make the experiments only before the first one. The students themselves came forward to make subsequent experiments. It was observed at that time that students liked having a choice. Imposing a concrete

experiment on an individual from above was less enthusiastically perceived by the person than being given a choice.

After an experiment, calculations were made which corroborated the results obtained. In the discussed cases, it was necessary to develop models of the considered systems, which offered an opportunity of reminding and reinforcing the knowledge of previously learned notions, such as external and internal forces; focused, surface or volume forces; forces distributed along a line – continuous loads, etc.

The final mark consisted of marks obtained in the short tests and the extra bonuses (the pluses) awarded during classes, owing to which it was possible to raise one's final mark by as much as one grade.

The distribution of students' marks in the groups where the expanded grading system was applied reminded with its shape of the Gaussian distribution (Fig. 2).

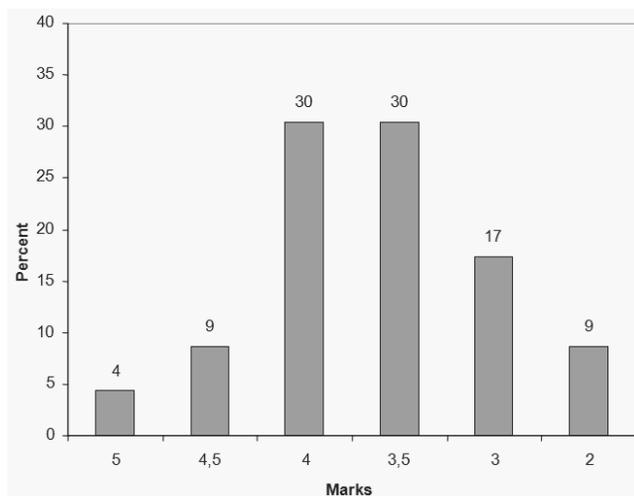


Fig. 2. Distribution of marks in the groups where the discussed motivating method was applied

The achieved marks may constitute one of the measures of effectiveness of the proposed method of conducting classes. However, an attempt should be undertaken to make them more objective by increasing the number of student groups where such classes are conducted and making a larger number of academics interested in such method of conducting classes. The described approach to classes in technical mechanics at this stage is only a proposal, the usefulness of which has been verified on the example of selected groups of students. A certain method of evaluation of such classes may involve surveys among the students.

#### 4. Survey made among the students

After finishing the class, a survey was made among the students in order to learn their opinions about the method of conducting the class and about the best, in the students' opinion, methods of motivating them.

The students emphasized that the system in which they weekly have short tests in the scope of the material covered at

previous classes was very motivating to them. Owing to that system, the students have an opportunity to check their knowledge on a regular basis. It is easier for them to catch up then.

Attention was also brought to larger variety of the grading system. It was affirmed that awarding persons who were active during the class was very motivating. The positive effect of the "pluses" was stressed.

It was also pointed out that people who aspire for higher marks should solve more difficult assignments at home. The responding students appreciated the possibility of preparing an experiment at home and then, demonstrating it in the class, in front of the whole group.

The students stressed that it was highly motivating to be shown by the teacher how they could use the acquired knowledge in their future work. A statement often appeared that it is the money that has the highest impact on the contemporary human being. This aspect of the didactic work, however, requires treating it separately. It is not possible to translate in a simple way the practical meaning of a given subject into guidelines describing the method of its implementation in the didactic process, so as to obtain the best possible results of applying the knowledge acquired. Usefulness of such knowledge would have to be taken into consideration in the entire context of problems covered by the syllabus for a given faculty and field of study, as well as in the context of the needs in the changing labour market. Presentation of the possibilities of using the acquired knowledge in everyday life was also evaluated as a motivating factor.

A motivating nature of a transparent grading system was emphasized, as well. The attitude of the teacher towards students is of a certain meaning. It is important that the academic should be open to cooperation with the student, and not only focused on the process of communicating knowledge itself.

The students also pointed out that team work positively influences the student's results. It is useful in building skills in cooperating with others while solving problems, and ensures mutual complementing in the scope of the possessed knowledge and skills.

#### 5. Summary and conclusions

Since it is not possible to introduce a uniform motivational system in all teaching establishments, it seems necessary to broaden the teachers' knowledge about the methods of motivating students to learn, with reference to a specific subject or education programme in a given faculty. The observations made refer to a faculty of a technological and material science profile, where the subject generally called "technical mechanics" does not belong to the main subjects in the syllabus, but it covers a large number of problems simultaneously, although with a limited number of hours assigned for teaching it. Making students aware of the significance of mechanics in their future jobs as engineers specializing in technologies, turns out to be really difficult in a number of cases.

Based on the survey and observation, the following conclusions have been drawn:

- The varying of the grading system offers the academic teacher a possibility of finding the strengths and weaknesses of a larger number of students;
- Experiments have a good influence on the atmosphere during classes, increase the activity of students and offer the

opportunity of achieving better marks to those who face difficulties in learning technical mechanics;

- Owing to the fact that students carry out experiments, they better acquire and consolidate the material covered during the class;
- The system of motivating students to learn should be taken into consideration with reference to both a particular subject and the entire complex of subjects covered by the syllabus in individual fields of study.

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