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TEACHING THE ETHICAL PRINCIPLES IN ENGINEERING EDUCATION

Keywords: engineering ethics; students' plagiarism.

The article looks at the historical and social factors that explain why engineering ethics has not been incorporated until recently in the training of engineers in Russia. The paper reports a survey of 120 university students on their attitude towards plagiarism as a professional ethics issue.

Ключевые слова: инженерная этика, студенческий плагиат.

В статье рассматриваются исторические и социальные предпосылки того, что в отечественном инженерном образовании проблемы инженерной этики не стали предметом широкого изучения. Приводятся данные опроса 120 студентов института полимеров об их отношении к проблеме студенческого плагиата.

Unlike in Russia, in the United States requirements of all engineering programs to address ethical issues were introduced by the Accreditation Board for Engineering and Technology yet in the early 1980s. By the late 1990s, however, in nearly 70% of the U.S. engineering institutions there still was no ethics-related course requirement for all students [1].

In 2000, the Board issued new Engineering Criteria which prescribed to further increase attention in the curriculum to the ethical responsibilities of engineers. According to the Criterion 3 of the document, "engineering programs must demonstrate that their graduates have

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs

(d) an ability to function on multi-disciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice" [2].

The ABET Criteria 2000 came at a time when the academic field of engineering ethics was radically growing, and the number of researchers focused on the topic was significantly increasing.

On the other side, experts cite numerous questions introduction of the new Criteria rose. Specifically, how to avoid overburdening faculty, increasing graduation requirements, and removing essential technical material from the curriculum while increasing attention to ethical responsibility in the engineering curriculum [3].

Among existing barriers for incorporating engineering ethics material within the engineering curriculum J.Herkert lists "indifference and cynicism towards ethics initiatives on the part of some engineering practitioners and educators, inertia of the discipline-based professional societies with respect to ethical issues in engineering, a lack of engineering faculty commitment to including ethics material in their courses, and a lack of student motivation for learning such material" [4].

It is also unclear how to measure and grade results of ethics instruction. Sarah K.A. Pfatteicher draws attention to the fact that the new Criteria demand that students understand ethics, not guarantee that students are ethical [5]. The issue is not about how ethical students are but about their ability to offer and defend a definition of "engineering ethics," to list and explain multiple reasons for being ethical, and to identify and critically analyze common ethical dilemmas, including possible responses, and consequences.

According to another view, "obligation to right action" is included on the list of elements of ethical reasoning alongside perception of a moral problem, assumption of universality and impartiality, and application of action-guiding rules and principles [6].

Tom Cooper reports results of a research during which 40 scholars at six leading English-speaking universities and in five additional leading departments were questioned on how ethics and moral philosophy were being taught [7]. Most participants were convinced that ethics instruction can effect changes in moral thinking, but divided on whether it is also the role and nature of ethics instruction to motivate changes in moral action. While 73% of respondents said ethics, when defined as moral reasoning, could definitely be taught, 40% opposed them. 40% of those asked believe teaching ethics can help make at least some students better persons.

As for the issue about where ethics instruction can be fit into the engineering curriculum, researchers propose different approaches. Michelle Bothwell and Joseph McGuire cite two major methods, including accomplishing ethics instruction through a course, or courses, offered by philosophy faculty, and integration of ethics content into the engineering curriculum itself [8]. Herkert attempted four models: "a required course in engineering ethics for all engineering students; an

across-the-curriculum model for engineering ethics; integration of engineering ethics instruction with material that focuses on the social context of engineering; and an integrated humanities and social sciences program that seeks to address all of the non-technical outcomes specified in ABET 2000 Criterion 3" [9].

Michael Davis focuses on eight ways of teaching engineering ethics in an academic environment [10]: (1) Independent study, for example, giving students the appropriate code of ethics and telling them to read it. (2) Study by special event, for example, a public speech on engineering ethics or a movie with a discussion afterward of the ethical issues it raises. (3) Holding students to an engineering code both inside as well as outside the curriculum. (4) The guest lecture. (5) A free-standing course in engineering ethics taught outside an engineering department, whether optional or required. (6) A course in engineering ethics which, while taught by an engineer in an engineering department, is still optional. (7) A free-standing required in-house course. (8) The pervasive method.

In Russia, engineering ethics developed during the soviet period in parallel with the formation of scientific intelligentsia which was affected by socio-political processes taking place in the country. This resulted in persecutions against certain scientific directions, such as cybernetics, genetics etc., as well as against specialists who were labeled "evil-doers" or "enemies of the nation". Classified scientific laboratories named "sharashki" (a word from prison slang) were also formed.

Why have engineering ethics issues not been paid due attention for a long time in Russia's engineering education and practice? The following reasons can be listed [11]:

- During the soviet era, when the economy was regulated by the state, an individual was separated from decision-making and simply implemented state-developed policy, technical activity was depersonalized, and ethical dilemmas were resolved at a state-run level.
- That resulted in the fact that technical specialists usually treated humanitarian issues "from above," as being insignificant and subordinate. The phenomena found its reflection in the known argument between the so-called "physicists and lyricists" that took place in 1950s and 1960s.
- It is specific for modern mentality to perceive financial and economic reality as the only social reality. In the market economy, employers are concerned predominantly about profit rather than ethical or even labor safety issues while ethical issues, both universal and engineering-related, are widely considered an anachronism.
- Falling prestige of the engineering profession and low demand for engineers lead to low interest in the issues related to engineering ethics among students.

During the post-Soviet period, engineering ethics issues appeared on the agenda of Russia's higher educational institutions in the late 1990s. Specifically, scholars from the Moscow Aviation University in the 1990s participated in a Russian-American project "Engineering ethics for Russian engineers," which resulted in inclusion of content related to engineering ethics into humanitarian disciplines.

A course of "Ethics in information technologies" has been taught over the past several years at the National Research Nuclear University "Moscow Engineering Physics Institute (MIFI)" as a part of a course devoted to humanitarian issues of information security. Nikolai Bauman Moscow State Technical University announced its plans to introduce an elective course on engineering ethics as of September 2011.

The goal of introducing engineering ethics, however, has so far not been given priority status, and curriculums of most technical universities lack ethics-related courses.

In the meantime, the widespread practice of students' plagiarism in universities, which creates obstacles for the promotion of such basic principles of academic work as the status of truth and novelty, has became an ethical issue of growing concern.

Judith A. Kolb, Hong Lin, and Deloise A. Frisque cite data of a 1999 survey of 2,100 U.S. students, according to which 75% of the students admitted to some cheating, as well as results of earlier studies reporting that cheating ranged from 9 to 95 percent, plagiarism 3 to 98 percent, and cheating on exams 4 to 82 percent [12].

In order to study students' opinion regarding plagiarism, a survey was conducted among 240 engineering students of the Kazan Technological University.

91 percent of students questioned confessed they have practice of textual copying or downloading free materials from the Internet to submit assignments while 7 percent said they have experience of hiring another person to complete an assignment. 57 percent of those questioned believe plagiarizing has a positive training effect. 42 percent of respondents believe over 75 percent of all assignments submitted by students contain texts borrowed without references while 43 percent estimated that portion as 50 percent.

Asked about the reasons of the phenomena, 76 percent responded that "there are hard-to-understand disciplines, and it is impossible to cope with the required workload." 56 percent noted that students do not have enough time to personally fulfill all requirements as many of them are employed and have to combine studying at universities with jobs. 33 percent said dense curriculum leaves little time to prepare original work. 29 percent believe students plagiarize since they do not plan to work as engineers after graduation and do not consider it important to obtain skills necessary for being an engineer.

Mentality traditions including weak respect for individual's intellectual property is among factors explaining wide spread of intellectual borrowing among Russia's higher educational institutions students.

Another factor is that universities do not develop and implement clear anti-plagiarism policies since they are not interested in expelling students for financial reasons.

Reliance on development of information technology [13] cannot be very helpful in preventing plagiarism while students remain tolerant towards unreasonable copying and lack of training in the ethical conduct of study and research proceeds.

Education of students against plagiarism can only be successful in case it promotes their consciousness of ethical values and engages them in ethical behavior in studying.

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