March-April 2020
ISSN: 0193-4120 Page No. 1872 - 1878

Some Issues of Development of Engineering and Technological Education

Rustam Khalmuradov, Professor of Samarkand State University (Uzbekistan)

Article Info
Volume 83
Page Number: 1872 - 1878
Publication Issue:
March - April 2020

Article History
Article Received*: 24 July 2019*
Revised*: 12 September 2019*
Accepted*: 15 February 2020*
Publication*: 16 March 2020*

Abstract:
The factors of improving the quality of engineering and technological education in the development of the modern economy of the republic are discussed in the article. Effective mechanisms for the organization of engineering and technological education are proposed. It is shown that his practical skills in the field of mathematics and information technologies are of essential importance in the engineer's development, since the successful solution of professional problems requires not only fundamental knowledge in the natural sciences, but also skills in the application of this knowledge in practice. Thus, the standards specify only the initial and final parameters of the specialist training, and the formation of the content of this training, contributing to the development of competence of future engineers, which is an urgent and difficult scientific and methodological task.

Keywords*: higher education, engineer, engineering education, two-stage system, quality of education, economics, technology, innovation, certification.*

Introduction.

2018 was named as the "Year of support for active entrepreneurship, innovational ideas and technologies" in our country in the message of the President of the Republic of Uzbekistan to OliyMajlis. It is necessary to rethink the role of higher education and above all, engineering and technological education in the light of the ambitious put forward tasks in the way of solving this program.

A structure and quality of engineering and technological education has a special place in the development of modern economy. The rate of economic development, especially industry, depends largely on the level of preparedness of this category of specialists. Before we analyze the current condition of engineering education, let us remember, what factors do its quality depends on? Without taking responsibility for all the interrelationships of all the parameters affecting to the studied question, I note only from my point of view, the most important:

- the presence of a high level of enterprises of the industry in the republic (modern samples of high standard) or the possibility of arriving production and other practices abroad

- physical and mathematical training at school and the work of children's technical clubs of interest

- qualitative composition of applicants

- composition and content of HEU course programs

- compliance list and content of curricula areas of education requirements branches

- the quality of the teaching staff

- composition and quality of the material and technical base, including first of all, the laboratory

- type of socio-cultural environment and mentality.

These factors generally form other forms of education.

Main parts of a research article. Fundamental changes in the economy in developed countries occur mainly through the development of high technologies. We can say that today there is a revolution in the economic sphere. This can be seen in the example of accelerating the appearance, on the

market of new products, their production cycles and reducing their lifetime. Moreover, this acceleration is not1-2 percent, but much higher in 3-4 years. Product lifetime in the market begins to be comparing with the time of its creation. For example, if a product is in demand throughout the year and then its popularity falls due to the appearance on the market of another similar product with high consumer qualities, then very often it is necessary to spend from six months to a year to develop and introduce this product into production [1]. The rapid changes in production based on the latest information technologies are also an incentive in accelerating the transformations of engineering and technology.

What requirements should meet engineering education at such a pace of economic development? Do these requirements differ from other groups of education areas?

I think that a block of engineering and technological areas of education and HEU of this profile expect some reforms that would contribute to the birth of innovative ideas and new technological solutions.

Firstly, it is necessary to take into account that innovative results in science require a certain HEU structure. Innovations develop primarily in the community of basic and applied sciences, i.e. in the structure of the corresponding university; there should be a serious block of fundamental studies, which most of all corresponds to the structure of classical universities.

Secondly, engineering education does not belong to the economic-forming area and therefore, its condition directly depends on the state of the relevant industry. “The country which do not develop high-tech manufacturing industry, build the appropriate education system focused only on the scope of repairing materials and servitude” [2].

In my opinion, the two-stage system also had a significant effect on the deterioration in the quality of engineering education. Multi-level engineer preparation turned out to be more popular economy than the undergraduate program, according to the leading experts of Technical HEI MGTU of Russia named by N.E. Bauman. In Europe, the pedagogical community is also considered the issue of introducing two types of Master's degrees: "Master of Science" (or "Master Researcher") and "Master of Profession" [3]. My discourses on master's education in our republic are published in the journal of "Education, Science and Innovations" (Tashkent 2017, №4, 46-48 pp.)

Transition to a two-stage system weakened the teaching of special (profession-forming) disciplines. In the two-stage system of higher education of Uzbekistan, the "bachelor" in terms of the capacity of its program is more academic than professional degree. Especially if we consider that the required level of quality is not reached the set yet. After the successful completion of reforms in pre-school, primary and general secondary education, it will probably be possible to return to the two-grade system of engineering education. Russia adopted the Bologna Declaration and the implementation of its main provisions is underway. However, in HEU of Russia, the question of the purposiveness of this system in engineering education is still being discussed. As far as I am concerned, its professionalization is required. For objective reasons, it is doubtful the possibility of preparing qualified specialists of engineering and technology directions in bachelor’s degree. This is possible if there is a strong material base (first of all, it is a modern experimental laboratory base), skills of students' independence, significant motivational arguments on both sides of the educational process.

The next important factor in improving the quality of education is the independent attestation of graduates. It should be noted that there is a two-level system of recognition of engineering qualifications in many developed countries of the world. The first stage is the recognition of educational programs for the preparation of bachelors through the procedure for their accreditation. The second stage is professional qualification of engineers through their certification and registration. Such a system is implemented in each country by professional

national non-governmental organizations - engineering councils, which are composed, as a rule, of the accreditation bodies of educational programs and certification of specialists: ABET (USA), ECUK (Great Britain), CCPE (Canada), IEAust (Australia) etc. The Association of Engineering Education of Russia (AEER) begins to function in Russia to accredit educational programs in the field of engineering and technology. In these accreditation bodies there are certain requirements of the engineering profession.

"In a broad sense, the engineering profession includes the activities of specialists at various levels. There are three levels of qualifications in English-speaking countries: engineer, engineering technologist, engineering technician, differing in the level of competence in the following activities:

- studying and solving engineering problems engineering design;
- application of knowledge and technologies based on mathematical, natural science and engineering problems;
- management of engineering activities and ensuring their effective interaction;
- understanding the impact of engineering activities, as well as legal, financial and other aspects of engineering activities on economy and social sphere;
- adherence to the ethical code of awareness of the responsibility of the engineering profession. We note that the accreditation of educational programs in the countries participating in the Washington Agreement is usually carried out by professional organizations that carry out certification and registration of professional engineers"[4].

It is known that the educational system, not related to production cannot train specialists for practical work. In a number of industries the economic component weakened, the engineering staff was scanty; the need for new personnel was negligible. Not all this awakens the employer to cooperate with educational institutions. The presence of high-tech, highly profitable production motivates their owners to demand from the educational system high quality of educational and scientific intelligence. And what is primary and what is secondary here? The classic answer is - good education is the key to highly efficient production. However, the difference between the technological and economic potential of the last socio-political system (from which we get out), and one in which we want to enter - is enormous, and the modern growth rates of the world economy based on high-tech, rapidly updated engineering and technologies (let us take, for example, the rates of updates in computer technologies) are incompatible with that of HEU. I think that the education system of many developing countries is in such a situation. It will take some more time and import of modern technology and technology, so that our economic structures can assess what quality and how much they need specialists with higher education and how they will be interested in the development of this educational system.

Another factor negatively affecting the quality of engineering education is a weak student population. This is due primarily to poor quality set. To say that the competition for the direction of engineering education is very low is impossible. Nevertheless, he is an order of magnitude lower than the so-called prestigious specialties. In addition, more prepared applicants go to prestigious specialties, who have undergone sometimes 2-3-year tutorial training. The low prestige of economic specialties (engineering, technology, agriculture, and some others) collects the rest, the poorly trained part of high school graduates. This leads not only to a significant reduction in the quality of the graduate and the graduation of a specialist diploma with all the ensuing consequences, but also to a decrease in the quality of teachers and the deterioration of the organization of the educational process. HEU is forced to pull more careless students than to perfect talented ones.

The holder of an engineering degree will be more competent if he owns any working professions of the corresponding profile. In a number of foreign

March-April 2020
ISSN: 0193-4120 Page No. 1872 - 1878

countries, an engineer's qualification is assigned by a special commission, after a period of work in production and perform qualifying work there. Probably, admission to HEU from the appropriate college profile could enrich such practical baggage of a future specialist. Vocational guidance work of the university here would play a positive role.

"Not one of the most advanced universities can produce only geniuses, as well as many outstanding personalities left the walls of weak universities. The priority of attention, time and effort: cutting talents or towing negligent ones is important," L. Volchkevich notes, speaking of negligent? (Higher education in Russia. No. 5, 2004).

How to solve this problem, which is one of the significant components of quality? I think that, first of all, the whole period of study, the principles of selection should function the elimination of the negligent should be inevitable and the need to abandon the fictitious "need" to accept a weak contingent, agreeing at first to some underload of teachers. It is better to bear such costs than the above described destructive. Moreover, over the course of several years, this problem will "resolve" due to natural loss.

There is a setting that the quality of a specialist sets the production. Due to the well-established technologies and low rates of their replacement and modernization, lack of funds for the technical re-equipment of investment enterprises, *it seems that to complete their official duties is enough education obtained in secondary school and partly supplemented by special knowledge in the workplace. ...*

For a number of reasons, the internal potential of universities for self-improvement is significantly lost. The current pace of development of technology and technology in the world is not comparable with the possible speed of self-development of the university. The way out of the current situation is seen in the need to create modern models of production structures (perhaps even at leading industry universities) as a result of the implementation of a special state program. And then, more accelerated "tightening" to them of vocational education.

Speaking about the quality of engineering education, we should separately note the role of mentoring. At universities in Europe and the USA, mentoring is an informal and well-established institute of the system for training specialists. In the USA, for example, it is the mentor who is called the supervisor (a more accurate translation of the term "adviser" - adviser, consultant). He helps the student to develop and implement his individual training plan, leads the student's creative work, conducts interdisciplinary coursework and laboratory work with him, supervises the preparation of graduation work and is engaged in his employment. ... As a result, a small teaching and research team is formed around each supervisor, consisting of students from different years of recruitment, undergraduates and graduate students (doctoral students or PhD students). All members of this team, as a rule, unite around a common scientific theme. Moreover, the topics of postgraduate and master's studies and the topics of coursework of senior students represent some different aspects of a common problem, financially supported by grants from various foundations and organizations or contracts with industry ... Constant communication with the supervisor, his personal example and the example of his older students have a great educational impact on the new members of the scientific school, give them a special "spirit" of the research team, cultural environment and creative work [5].

One more reserve of positive influence on the quality of engineering education is professional-oriented teaching of natural science subjects. "In a technical university, the abstract nature of the disciplines of the general education cycle turns out to be a serious obstacle in mastering the subject side of the engineer's activities. This especially applies to the course of mathematics, where the level of abstraction is so high that not only the practical application of acquired knowledge, but also their use in senior courses becomes problematic for students.

The official traditional goals of teaching mathematics are the development of skills in operating with abstract objects, the improvement of mental operations, the development of logical thinking, etc. - orient the teachers to the formation of a rather narrow circle of elements of the future practical activity of a specialist.

Thus, when teaching students in the mathematical and natural sciences, it becomes necessary to introduce contexts of the near and distant future into the educational process. The nearest future is training at senior courses, the distant future is labor at work ”[6].

The theoretical foundations of professional disciplines (theoretical mechanics, the theory of mechanisms and machines, the strength of materials, structural mechanics) are taught in approximately the same courses as natural science. The consistency of their work programs in time and content, jointly thought-out tasks of practical exercises is one of the solutions to the problem. For example, “... the problem of vocationally-oriented math education has three main aspects. The first is to determine the content of vocationally oriented teaching of mathematics, the second is related to increasing the motivation to study mathematics, and the third is to find means of implementing vocationally directed education and developing methods for their use. ... However, the substantive and methodological aspects of vocationally directed mathematics education for future engineers are developed poorly for most specialties. There are practically no professional-directed textbooks and problem books for students of most specialties of technical universities” [6].

Different areas of engineering education should have the appropriate content of professional-oriented programs of mathematics, physics, chemistry, etc. These programs include the introduction of professionally significant material showing the relationship of auxiliary subjects with future professional activities. More than twenty professionally directed problem makers, laboratory workshops in mathematics, physics, and biology for non-core areas of education were prepared and published at Samarkand State University [7].

“... to successfully solve professional problems requires both fundamental knowledge in the natural sciences and skills to apply this knowledge in practice. Thus, the standards set only the initial and final parameters of the preparation of the subject, and the formation of the content of this training, contributing to the improvement of the competence of future engineers, is an urgent and difficult scientific and methodological task. It is important. that students, systematically solving vocationally oriented math problems, do not just study mathematics, but also consciously learn to apply knowledge of mathematics in their future professional activities, and this means a new, competence level of students' mathematical training” [8].

“The fundamentalization of the content of education involves mainly strengthening mathematical and natural science training. It is advisable to carry it out on the basis of the backbone fundamental academic discipline (that is, discipline and should become a backbone factor) as for the integration of scientific knowledge (fundamental and special) in the professional training of an engineer-researcher, designer, technologist.

For each specialty, it is necessary to define a set of particular special tasks, the method of solving which assumes that the level of knowledge of fundamental disciplines will allow solving educational tasks of an educational nature: to form a broad erudition, system thinking; bring up activity character” [9]. The objectives of teaching mathematics at a technical college are to ensure that a student, firstly, receives fundamental mathematical training in accordance with the university program and acquires a mathematical culture, and secondly, masters the skills of mathematical modeling in future professional activities (skills of applying mathematical knowledge in engineering work). Meanwhile, it should be noted that it is very often the second component of the purpose of teaching the

formation of mathematical modeling skills that, for a number of reasons, sufficient attention is not paid.

In order for students to learn how to apply engineering knowledge in engineering activities, understand their importance for practical work, a certain integration of the course of mathematics with the cycle of professional disciplines is necessary, which implies both "full functionalization of special knowledge" and "specialization of fundamental knowledge".

"... the principle of professional orientation presupposes, as a freshman, immersion of a student in the context of future professional activity: the inclusion of professionally significant knowledge in the content of education, showing the connection of mathematical concepts, theorems, methods with his future engineering work, as well as the organization of a quasi-professional activity aspect of this work. Complexes of professionally directed mathematical tasks not only make it possible to form professionally oriented learning content, but at the same time they become a learning tool "[10].

Another factor in ensuring the quality of engineering education could be the presence of an appropriate production base at HEU. As an experiment at several leading higher educational institutions together with foreign firms and companies, with the participation of foreign universities partners could be created joint ventures. These productions could have a double function. The first is a sample of a modern enterprise, probably, for its further replication; spread his spirit and philosophy. The second is the "testing ground" for the university, where the introduction of new ideas is possible. These bases differ from technoparks practiced abroad. They are more needed for "pulling up" the university to a higher level in the shortest possible time, and then the opposite should happen - the innovative influence of the university on production. This can be started with universities, training specialists in agricultural, mining - processing, textile areas of education. Of course, financial and organizational assistance from the state is needed here. Preferential bank loans to the university (after all, HEU should be the guarantor and the main partner of such an enterprise), diplomatic support when working with foreign partners.

For example, the creation of a modern construction organization (with all its infrastructures) at an engineering-construction institute, and an exemplary cattle-breeding farms, gardens, fields with an agrarian one ... etc., would be a great help in updating the university psychology inherited from previous economic system. Its practical skills in the field of information technology become essential in the formation of the engineer. Not to mention the fact that a graduate of an engineering university should be able to freely "communicate" with a computer to receive and transmit necessary information, be able to work in office mode, he must solve engineering problems using a computer, carry out drawings, build at least simple models of the problem being solved. ""Obviously, it is necessary to restructure the entire educational process in the course of computer science, using the so-called problem-oriented approach to learning" [11].

The quickest ascent of all or most HEU engineering and technology areas is difficult, if only because this type of education is expensive. It will be possible to work out their own model of technical education starting with the priority industries.

REFERENCES

1. Smirnov S. The Bologna Process: Prospects for Development in Russia. // Higher education in Russia. 2004, No. I. pp. 43-51.
2. Senashenko V. Volodin N. WTO and the problems of higher education. // Journal: "Higher Education in Russia", 2006. No. 2. pp. 8-13.
3. Fedorov I., Korshunov S. Yorkovich S, Suvorov S. Development of criteria for the list of single-level educational programs in the specialties of HPE.// VOVR 2006, No. 5. pp.3-11.

4. Chuchalin A., Boyev O., Kriushova A. Quality of engineering education: global trends in terms of competencies. // VOVR, 2006. No. 8. pp. 9-17.
5. Grebnev L., Popov V. On the organization of higher technical education in the United States. // Journal: "Higher Education in Russia". 2004. №11. pp. 150-165.
6. Larionova O. Competence - the basis of contextual learning. // Journal: "Higher Education in Russia". 2005 No. 10. pp. 118-122.
7. Hayamuradov R. About professional-oriented training. / 'Journal: Education, Science and Innovation. Tashkent, 2017. No. 2. pp. 73-75
8. Noskov M., Shershneva V. Competence-based approach to teaching mathematics. // Journal: “Higher Education in Russia”, 2005. No. 4.pp.36-39.
9. Yevstigneyev V., Gorbunov S. On the integration of fundamental and special knowledge in the training of engineering personnel. // Alma Mater, 2005. No. 8. pp.12-14.
10. Noskov M. Shershneva V. Mathematical training as an integrated component of engineer competence. / '/ Alma Mater, 2005. No. 7. pp.9-13.
11. Dolinina O. IT - Education Today: Problems and Prospects. // Journal: "Higher Education in Russia", 2006. No. 2. pp.98-103.