

Multidisciplinary School as a BME Teaching Option

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Abstract— The paper presents aims and organizational backgrounds of the Multidisciplinary School of engineering In Biomedicine founded in AGH-University in Krakow. In the context of current issues concerning the education of biomedical engineering in Poland, the advantages of multidisciplinary approach are highlighted. The School organization resembles well a typical faculty, however allows great flexibility in adjustment of the teaching process and schedule to the demand from employers and to available human and material resources. The paper also highlights the School activity in areas in wide sense related to the education of professionals: stimulation of employment needs, scientific initiatives of students and support of improvement in education quality.

Keywords— BME Education, Multidisciplinary Learning, Education Quality, Students Initiatives.

I. INTRODUCTION AND CONTEXTUAL OVERVIEW

Reporting about the novel approach to the biomedical engineering (BME) education in Poland has to begin with the introduction of a legal regulation including national standards for academic teaching by the Ministry of Science and Higher Education [1]. This was a response for a bottom-originated initiative claimed first by the AGH-University of Science and Technology alone, rejected and repeated two years later by the consortium of eight leading technical universities in Poland.

This consortium was possible to be established thanks to the experience and material base every university already had in teaching selected elements of biomedical engineering as parts of other faculties. Main such areas include: electronics, computer science, material science, mechanical engineering and robotics. The background was particularly strong in scientific activity focused in development of medical applications in these domains.

In the decade 1995-2005 our University had a particular opportunity to be governed by one of the pioneer of biomedical engineering in Poland, professor Ryszard Tadeusiewicz [2]. His insight from the rector chair revealed how much scientific effort is made towards the medical

applications of various technologies separately in particular faculties. That risen first idea of a multidisciplinary institution rooted in the University structure and governed by the board composed of representatives of each faculty involved. Such board was brought into existence and in result of few organizational meetings aimed at roles and tasks sharing, the University Council (Senate) was officially asked for the foundation of a new institution. This was the Multidisciplinary School of engineering In Biomedicine (MSIB), supported with professors of four faculties. These people remain employees of their mother faculties, but delegate their teaching entitlement towards the education track of biomedical engineering. In this way it was easy to comply with the minimum number of authorizing professors required by national regulations.

The recruitment for candidates was first ready and conditionally approved by the University Senate in the late spring 2005 - unfortunately, the Ministry delayed his legal works and consequently we had to wait one year more before launching new educational offer. Next year, thanks to having all details prepared well in advance, the recruitment was announced the next day after the legal act appearance. This led to complete all preparatory work by the end of July 2006 and to inaugurate new academic year in October the 1-st as first Polish university offering full-time two-degree studies in biomedical engineering. Being a little ahead of other currently available offers, gives our first graduates a privileged position in the work market, however the lack of predecessors requires particular care and awareness from the board and teaching staff [3-5].

II. AIMS AND ORGANIZATION OF THE INSTITUTION

A. Organization scheme and place of MSIB in University structure

The MSIB is organized similarly to educational structures of other faculties. It is governed by the Board of 18 persons in which professors having minimum DSc (habilitation) degree and students are represented. The makeup of

the council is authorized by the University Senate. Currently, professors represent five faculties:

- Faculty of Electrical Engineering, Automatics, Computer Science and Electronics,
- Faculty of Materials Science and Ceramics
- Faculty of Mechanical Engineering and Robotics,
- Faculty of Metals Engineering and Industrial Computer Science
- Faculty of Physics and Applied Computer Science

The Board competence is to propose the Rector to nominate the Head and the Deputy Head of the School. The nominated Head is the executive and the President of the Board. Main goal of the Board is supervising the education process quality, correcting its timetable, staff assignment and realization of other main goals of the School. The Head is representing the MSIB in the University Board equally to deans of other faculties.

From the student's viewpoint, there is no organizational difference between the faculty and the School, both having a dean's office, a social support system and students board. As far as education aspect is concerned, the Head of the School has rights and responsibilities range identical to the dean.

B. Main goals in educational and education-supporting areas

Except for main goals directly related to the stationary and non-stationary education, the mission of MSIB include several aspects important to creating the favorable environment for development of biomedical engineering:

- coordination of AGH-UST scientific activities in the field,
- promotion of the biomedical engineering as new profession in secondary schools, healthcare institutions and industry,
- cooperation with scientific and educational institutions as well as with national and international societies of professionals,
- organization of scientific and educational conferences, development of educational materials, books, lectures and electronic records,
- coordination and support for student scientific initiatives (scientific societies, national and international mobility etc.).

Such a wide range of promotional activity is oriented towards improvement of education results and social impact. The strategic plan include building a professional society of biomedical engineers in Poland and setting employment privileges as necessary to rise the healthcare standards.

C. Rules of lectures allotment and accounting

The School does not have its proper teaching staff. Instead it uses formerly practiced ways to order lectures and courses from other faculties. Main recipients of teaching orders are founding faculties except for pure medical lectures (anatomy, physiology etc.) outsourced by professors of Jagiellonian University Collegium Medicum. Every faculty declares the contribution of office expenses in the teaching costs (for AGH-UST it is standardized as 15%). Ordering a course from a particular faculty causes proportional funds flow based on the contact time for all costs except for office expenses that constitutes the income of the MSIB. This funding is spend to organize the teaching process, dean's office expenses, social support, score awards etc.

Ordering a course from a particular faculty is an independent decision of the Board, usually based on the teaching quality. Consequently, in case of general courses (mathematics, physics, chemistry etc.) the Board may select best courses available in the AGH-UST and thus students of MSIB are privileged by learning from leading professors in best-equipped laboratories.

III. ACTIVITIES SUPPORTING THE EDUCATION

A. Promotional role for new profession in the society

New profession of biomedical engineer needs to be promoted in the society to rise the interest and the awareness of its necessity. For this purpose, the Board of MSIB with scientific staff and students participation organizes and supports several activities oriented towards the average citizens. First such event are Opening Days allowing to present the laboratories, attractive experiments, unknown fact about human body or medical techniques. This event is usually planned in the spring and coordinated with information days for candidates. Its continuous counterpart is a website of the MSIB providing necessary information concerning the study and the professional live of example biomedical engineers in Poland. This is completed by the address list of prospective employers from the industry, healthcare and science. This role also has the quarterly printed journal entitled "*Engineers for the Biology and the*

Medicine", highlighting selected aspects of students professional interest and activities.

B. Activating the employers cooperation

Recipients of our educational efforts need also to be prepared for new personnel available in few months. Two ways of cooperation with the prospective employers are practiced:

- involvement of the employers in interim employment or training programs,
- participation of the employers in modification of teaching program

One particular aim in this area is closing the gap between the knowledge and skill areas expected from students by the academic staff and required by the future employer.

C. Support for scientific initiatives of students

As one of the employment option for the graduates is the academic career, interested students with particular predispositions should be identified and motivated. Student scientific societies are best way to approach the scientific life of the university and to encourage students own creativity and original viewpoint. Students interested in biomedical engineering (not necessarily participating in biomedical engineering track, organized themselves in a IEEE Student Club recognized by Biology and Medicine Engineering (BME) Society. Participants are mainly, but not exclusively students of medical physics, applied computer science and biomedical engineering tracks. For the lack of older classes of biomedical students, the scientific society members provide guidance and play important advisory role for their younger colleagues.

D. Coordination of educational progress and scientific activity

The other activity of the Multidisciplinary School of engineering In Biomedicine is the University-wide coordination of scientific projects and efforts towards improvement of education. Starting from the cross-faculty human resources reference and the electronic library of biomedical engineering papers, the School plays advisory role for connecting best available people, instrumentation and skills through all four faculties. Last year we launched a cyclic bi-annual National Conference on Biomedical Engineering Education [6], which was a platform for exchange of ideas, problems and solutions specific for the teaching of that track in several Polish universities. The other important role

of the conference is to coordinate the educators actions influencing the Ministry of Health, and Ministry of Science and Higher Education. Under the auspices of MSIB the first handbook of biomedical engineering in Polish language was prepared for candidates and students by 67 authors from different origin [7]. Subsequent publications are already in editing.

IV. PRELIMINARY RESULTS AND SOCIAL IMPACT

Since we don't yet have graduates, the objective measurements of our result by the professional skills in not possible. Instead, we have to make a preliminary estimate based on:

- interest for the topic and studies measured as candidate flow and quality,
- partial feedback from the industry,
- students opinion

The track of biomedical engineering has a reputation of one of harder in our University and therefore attracts mainly good candidates. For 150 candidates accepted in 2008, the average high school finals was 88,2% (minimum 82,2%). Nevertheless, although the total capacity of our offer was fairly high, we were far from satisfying 785 candidates interested in studying (5,2 persons per place).

Last year, in result of four weeks practical training we had also first comments from the cooperating institutions (hospitals, laboratories and industry). Their general opinion was moving the focus of the Board even more towards insisting on practical activities of students, which contribute now in 55-65% of studying time. The other issue risen by prospective employers concerns innovative aspects of the teaching and students creativity. It is the concern of the future how to score students more for their own ideas and not only for fulfilling predefined tasks.

V. DISCUSSION

A. Application-oriented education

Standard approach divides disciplines with respect to used tools. Electrical, mechanical and material engineering are into the main focus of biomedical engineering. These are, however, fast growing disciplines requiring continuous learning during all the professional life. At the very beginning of the employment as biomedical engineers, graduates of these faculties, have to close their knowledge gap in medical and biological sciences, and simultaneously keep

up with the progress in their basic discipline. Approaching to a specific problem they will naturally favor one solution (e.g. electronic-based approach), while being less self-reliant and thus requiring cooperation in other domains (e.g. mechanical or tissue engineering).

B. Medicine-based approach

The teaching approach we propose consists in broaden the basis of fundamental disciplines by including elements of medicine and biology. The student interest is guided by the prospective employment in health-related services (medical, scientific and industrial) and developed towards high understanding of the human in any conditions and of the specificity of healthcare. These fundamentals are changing relatively slowly and the perspective motivates young people for a hard work in studying of wide range technical backgrounds.

C. Multidisciplinary search for solutions

Such approach is expected to bring also the advantage of multidisciplinary aspects of future engineers approaches to solving problems. In the research for possible solutions the biomedical engineer is not limited by the traditional confines of disciplines and pertinent in wide area of technical knowledge and skills. Considering also the responsibility and ability to work under stress and time constraints expected from students as necessary for working in the healthcare, our teaching approach leads to educate an engineering professional expected and hopefully accepted well also in the industry not directly related to the medicine.

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