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Procedia Engineering 60 (2013) 214 – 219

Procedia Engineering

www.elsevier.com/locate/procedia

6th Asia-Pacific Congress on Sports Technology (APCST)

Sports technology education at Mid Sweden University

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Received 20 March 2013; revised 3 June 2013; accepted 9 June 2013

Abstract

In present paper we would like to share some experiences of building new education in Sports Technology at Mid Sweden University and the results of 10 years of successfully running it in Östersund. The Sports Technology education at Mid Sweden University started at Campus Östersund in 2003 as a part of the curriculum of the Engineering Department. This specialization was initially at the three-year Bachelor level, and later it was extended to an additional two-year Master level. Aiming at the quality of Sports Technology education, three keystones are underlying its process, representing the solid knowledge base, capacity to be flexible in problem solving and the use an innovative approaches. The Department unites researches with a background in both natural sciences and engineering disciplines, having a wide experience of working with and within the industry, equally active in research and teaching. The unique constellation of the profiles forming the Department include not only the SportsTech® group, being "the backbone", but also the Ecology and Eco-technology, and Quality Technology groups bringing the excellence and extra competence needed to assure the quality of the Sports Technology education. We were the first higher education institution in Sweden to give this kind of education program and now some other Swedish Universities have followed us. Our success can be measured by a number of graduates taking good jobs in the industry. We also enjoy a steady flow of new students coming from all parts of Sweden, and Sports Technology education stays among the most desirable ones in the country.

Selection and peer-review under responsibility of the School of Aerospace, Mechanical and Manufacturing Engineering, RMIT University

Keywords: Sports technology; university education; engineering of sports; outdoor

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Selection and peer-review under responsibility of the School of Aerospace, Mechanical and Manufacturing Engineering, RMIT University
doi:10.1016/j.proeng.2013.07.037

1. Introduction

Knowledge is a very specific product "produced" by the undergraduate schools and universities. Though its "production" is to a significant extent planned and regulated, nowadays it is more and more influenced by the truly market-driven balance of the supply and demand. The unfortunate tendencies developed in Sweden and other countries towards the beginning of 21st century were leading to a significant loss of interest from the potential students to the Natural Science and Engineering education High School (University) programs, as compared to the Social and Humanitarian Sciences [1, 2]. Also in the fall of 20th and the beginning of 21st century Sweden has entered the demographic situation with the numbers of school graduates steadily declining [3]. Simultaneously, the growing interest of the population to the sports, active life style and outdoor activities in Sweden and in particular in some of its local municipalities has led to a growth of the domestic and international businesses within sports and outdoor sector [4-6]. To survive in a very competitive sports and outdoor industry environment regional and Swedish businesses have started actively searching for young specialists with appropriate skills. So it was decided that Mid Sweden University should develop new education program "generating" young specialists who could graduate and go to work at the sports and outdoors companies.

It was decided that this education flow should be oriented towards science and engineering applications within the technology for sports and outdoor activities, so that the graduates would be able to strengthen the traditional industries widely represented in the region of Jamtland as well. Though the main area of sports and recreational activities in our region is determined by the geography and climate and is related to winter, it was decided that we should not explicitly concentrate at the winter sports, but provide broader basic education background at the same time allowing the students significant freedom of choice of the practical projects they undertake in their studies.

2. Foundation and keystones of sports technology education at Mid Sweden University

2.1. Foundation

The sports technology education, at Mid Sweden University was started at Östersund Campus in 2003, initially only at the three-year Bachelor level, and later it was extended to an additional two-year Master level. At the very early stages of the development of this new education program the need to have a solid foundation was rather clear.

It was decided that due to the applied nature of the tasks young specialists should perform working in industry, new Sports Technology education should be a part of the Engineering education flow. So the students should have mainly practice-oriented engineering education complemented by the courses and disciplines reflecting the specifics of the applications within the chosen field. The education program is called "Engineering, with the Applications into the Sports and Outdoor (Adventure) Technology", and today it is a part of the education provided by the Department of Engineering and Sustainable Development at Mid Sweden University. Further in the paper this education flow will be referred to as Sports Technology.

2.2. Balance

The first and central keystone for our Sports Technology education is a balance of studied disciplines. Taking into account that the job market is very dynamic, it was decided to keep a balance between the "traditional engineering", modern technologies and material sciences, and Sports related disciplines. This balance is constantly analyzed and at some points adjusted by the Department so that our graduates can

take the jobs not only within the academic research, Sports and Outdoor industries, but virtually at any place in need of modern engineer. Thus our graduates can be quite flexible in terms of the choice of particular areas they will choose as their future work place.

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2.3. Innovation and creativity

Another keystones cluster in our Sports Technology education is innovation and creativity in problem solving. Contrary to the often existing misconception it is possible to teach students to be creative and innovative [7-12] when solving problems. Within Bachelor program (see Table 1) it is achieved within following courses: Design and Prototyping, Project Management, Customer-Focused Product Development, Innovative Product Development and Environmentally Driven Innovation.

Table 1. New Bachelor education flow- Sports Technology at Mid Sweden University (starting in autumn 2013), breakdown into quarter-year courses

Year 1		**Year 2**		**Year 3**	
Math A, Introduction Course	Introduction to Sports Technology	Environmentally Driven Innovation	Biomechanics	Matematical Statistics and Linear Algebra	Innovative Product Development
Design and Prototyping	Customer-Focused Product Development	Environmentally Driven Innovation	Design and Virtual Prototypes I	Design of Experiments	Computer Aided Engineering
Introduction to Calculus	Project Management	Intro to Strength of Materials within Sports Technology	Anatomy and Physiology in Sports Technology	Statiscs and Dynamic Modeliing	Applied Biomechanics
Manufacturing Methods	Contemporary Materials	Applied Measurement Technology	Design and Virtual Prototypes II	Final Project	

2.4. Contemporary engineering

Yet another cornerstone in our Sports Technology education is the courses driven by the state of the art science and technology. For example, in the course on Manufacturing Methods significant attention is paid to the Additive Manufacturing technologies [13, 14]. In the courses Computer aided Engineering, Design and Virtual Prototypes, Statistics and Dynamic Modeling students are introduced to and learn to work with the modern computer modeling and finite element analysis methods, becoming an important integral part of the modern “toolbox” of the engineering specialist.

2.5. Application driven approach

One can say that orientation to the practical needs and constant attention to the applications is the main canvas for the education process within our Sports Technology education. A brief glance at the Table 1 listing the Bachelor courses undoubtedly supports this thesis. The main task of our teachers is to give the students adequate knowledge so that they can go through the full process of product development using

appropriate tools, perform computer modeling and necessary FEM analysis of the components and elements, and to manufacture the physical prototype in polymers or/and metal. To allow such completeness of the design flow, students get the access to our additive manufacturing laboratory with a wide set of additive manufacturing tools, capable of working with different polymers and metals and alloys (ARCAM electron beam melting additive manufacturing machine, by ARCAM AB, Sweden allows to work with titanium, some steels, cobalt-chromium alloy and, quite recently, bulk metallic glasses [15]).

3. Integration with the research and with the industry

3.1. Integration with research

The sports technology education is intrinsically coupled to the research activities carried out at the Department. The Department unites competent and dedicated researches with a background in both natural sciences and engineering disciplines, having a wide experience of working with and within the industry, equally active in research and teaching. The unique constellation of the profiles forming the Department includes not only the SportsTech® group, being "the backbone" for the Sports Technology education, but also the Ecology and Eco-technology, and Quality Technology groups bringing the excellence and extra competence needed to educate modern application-centered specialist.

3.2. Cooperation with industry

At the moment in different projects we cooperate with more than 40 locally represented and national and international companies active within the sports and outdoor technologies, sports and outdoor garments and also the service providers within this industry sector. These companies range from "one-person company" to the internationally renowned sports garment manufacturers.

Through the years of successful cooperation with the industry we were able to set the links with the industry based on a constructive dialog. Two major components of our cooperation here are represented by the joint research projects and joint final projects for our students. The latter component became so successful, that the dominating majority of our graduate students are taking their final projects together with, or directly within the local companies. Also, within the final project the students are always encouraged to use their knowledge in design and prototyping and, ideally, show the real prototypes when presenting their final exam work.

So, education, industry and academic research are forming a bonded triangle of relations, helping us to progress in Sports Technology. As an example of such relations we can mention the results of the development project supported by the Swedish National Agency of Regional Development. Within two years the University together with local companies active in manufacturing products for Sports and Outdoor activities has set up a laboratory, which became a prototype of an "Open Access Center" hosting equipment for the textile related testing and research. This laboratory is intensely used within our education process (for example, for the course Modern Materials), and for the final projects. Simultaneously, more companies are joining this "Open Access Center", and new research projects using this equipment are in the pipeline.

As a result of the education program, quite a number of students have founded their own business companies. These companies are to a great extent based of product ideas that have been conceived during the education and they do hold a number of patents or other IPR related to the product ideas.

4. Quality assurance

The Sports Technology education, as any other in our country, is of course subject to the accreditation by the Swedish National authorities. But this accreditation, though vital, is only a part of the quality assurance process. The quality assurance and course development work is carried out continuously. It is mandatory in Sweden to evaluate each course after every completed academic year. First part of it is done by the students after the exams by filling in anonymous question forms, where all of the course components are scrutinized. During the next stage the companies provide a feedback on their opinion about student's performance when working with the company after having completing the SportsTech program. And during the last stage the teachers provide their opinion and summarize all the data acquired deciding on the measures to be taken to improve the education process. This continuous quality assurance and development work is not only related to the courses as such, but is also used to assure the engagement of students, companies and the university in the joint research and development activities [16, 17]. Long-term cooperation with local companies has proven that the SportsTech program satisfies well the needs of the profile industries in recruiting young, dynamic and competent personnel.

5. Conclusions

In the years passed we were able to build up a sustainable educational system graduating technology specialists for the sports and outdoors industries. We were the first higher education institution in Sweden to give this kind of education program, and although some other Swedish Universities have followed us, we are still keeping the first ranking in the country. Our success can be measured by a number of graduates taking top jobs in the industry and successfully continuing research. Quite a number of students also founded their own business companies. These companies are to a great extent based of product ideas that have been conceived during the education and they do hold a number of patents or other IPR related to the product ideas. We also enjoy a steady flow of new students coming from all parts of Sweden, and sports technology education stays among the most desirable education flows in the University. Our Sports Technology education is continuing to be one of two most attractive technical educations in Mid Sweden University.

Today we are convinced that the success of high-school and university Sports Technology education is coming through the tight cooperation with the profile industries: technology shapes education, education shapes technology [20]. Among the key factors determining this success are the continuous process of quality assurance, proper balance between the teaching of fundamental science disciplines and applied ones, and development of the innovative thinking of the students, all of the above basing upon strong research programs.

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