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Experience of Students' and Teachers' Pilot Training in the Field of Environmental Engineering in a Post-Soviet Country

Dagnija Blumberga[1], Elina Dace[2], Jelena Ziemele[3], Igor Koshkin[4], Zauresh Habdullina[5], *[1-3]Riga Technical University, [4]A.Baitursynov Kostanay State University, [5]Rudny Industrial Institute*

***Abstract* – Kazakhstan is one of the Post-Soviet countries with remains of the Soviet educational system. Yet, in 2010 Kazakhstan joined the European Higher Education Area (the Bologna Process) that requires focusing on 10 Action Lines and taking into account the Process' fundamental principles. A consortium of universities representing Kazakhstan, Russia and European Union countries developed within a Tempus programme project to enhance a transition and compliance with requirements of the Bologna Process in the field of environmental engineering. Within the project, the academic staff of Riga Technical University (Latvia) implemented a pilot training concept in Kazakhstan higher education institutions. This paper presents the methodology applied and verified in two Kazakhstan higher education institutions and discusses the results achieved. It is concluded that collaboration of academic staff from countries with a common past has many benefits when an innovative training concept is implemented. It helps to acquire a better understanding of the situation and find more effective solutions in the academic, scientific and industrial spheres. The methodology applied proved to be efficient to encourage the students' critical thinking skills and further develop the curriculum of environmental engineering in Post-Soviet countries.**

***Keywords* – Academic exchange, Critical thinking, Post-Soviet countries, Students' training.**

I. Introduction

Lately, European Union universities focus on collaboration with Post-Soviet countries. Most frequently, within the TEMPUS programme, which supports the modernization of higher education in the European Union's surrounding area. Tempus promotes institutional cooperation that involves the European Union and Partner Countries and focuses on the reform and modernization of higher education systems in the Partner Countries of Eastern Europe, Central Asia, the Western Balkans and the Mediterranean region [1]. Within the activities of the Tempus programme project "Development and implementation of the Master Programme -"Eco-Engineering – environmental processing and sustainable use of renewable recourses and bio-waste" (Green Engine), an experience exchange for the enhancement and improvement of environmental engineering curriculum was carried out through collaboration of technical universities. The academic staff of the Riga Technical University (Latvia) implemented an innovative Pilot training project in A.Baitursynov Kostanay State University (Kazakhstan) and Rudny Industrial Institute (Kazakhstan). The aim of this paper is to present the methodology applied and discuss the results achieved.

II. Literature review

During the last decade, the international mobility of scientific and academic staff has globally become an integral part of the higher education [2]. Collaboration and integration in education worldwide is one of the main priorities of Kazakhstan policy, as well. In March 2010, Kazakhstan joined the European Higher Education Area (the Bologna Process) [3]. Joining the Bologna Process is led by the necessity to integrate into the modern global educational area by creating a competitive education system [2]. Thereof, for Kazakhstan, the issue of academic exchange and mobility is of special importance. The concept of academic mobility of students of higher educational institutions of the Republic of Kazakhstan [4] defines an academic mobility as "the movement of students or teachers and researchers for a specific academic period (including education or production practice) (..) to another higher educational institution (domestically or abroad) for studying, teaching or research (..)". As stated by Bazhenova [2], the aim of academic mobility is to give students an insight into universal European-level education in the chosen field of study. However, the problem that hinders full realization of the mobility is students' and teachers' lack of foreign language skills, particularly English [5]. Based on a series of observations during their teachings at the educational institutions in Kazakhstan, Yergebekov and Temirbekova [5] have concluded that in Kazakhstan's higher education system the Bologna Process has been introduced as a formality solely without practical functions. The statement by Burkhalter and Shegebayev [6] that the practices of Kazakhstan teachers serve as a barrier to the implementation of student-oriented and collaborative practices that promote critical thinking adds to the Yergebekov's and Temirbekova's conclusion. Our study, however, shows that the higher education system in Kazakhstan can be enhanced by developing an environmental engineering curriculum and applying a specially developed training concept.

The Tempus programme has a strong impact on curriculum modernization. The projects implemented within the Tempus programme demonstrate new approaches to developing interdisciplinary curricular [3]. The aim of the Green Engine project is to develop and implement an interdisciplinary Master program on environmental processes and energy

engineering based on renewable energy sources and bio-waste to avert the lack of relevant specialists, educational background and practical experience. That will help Kazakhstan to implement environmental policy and attract relevant foreign companies to invest in this area [7]. An additional activity of the project is an experience exchange and academic mobility that would give the Kazakhstan students and teachers insight into the European approach to the relevant problems.

III. METHODOLOGY

In September 2013, the academic staff of Riga Technical University implemented an innovative Pilot training project in two higher education institutions in Kazakhstan. The topics covered included renewable energy sources and technologies, environmental indicators and technologies, district heating systems, energy efficiency of buildings, technologies of boiler houses and cogeneration plants, and waste management systems. The training included lectures, practical works and a study tour to a large-scale industrial site. The main idea was to give students and teachers as much experience as possible in a short period of time (one week) by applying extraordinary methods and giving tasks where critical thinking is practiced. Thus, the first two days of the training were devoted to theoretical aspects of environmental engineering (lectures). Then, students together with the academic staff visited an industrial site – a beer factory (see Fig. 1), where all the technological processes were shown and explained. Finally, the last two days were devoted to practical works.

Fig. 1. Students and teachers visiting the beer factory.

The practical works were completed in several stages. First, the technological scheme of the production process was drawn and discussed and problematic areas identified (see Fig. 2). The data provided by the beer factory contributed to the problem identification process. An example of data processing results is shown in Figure 3.

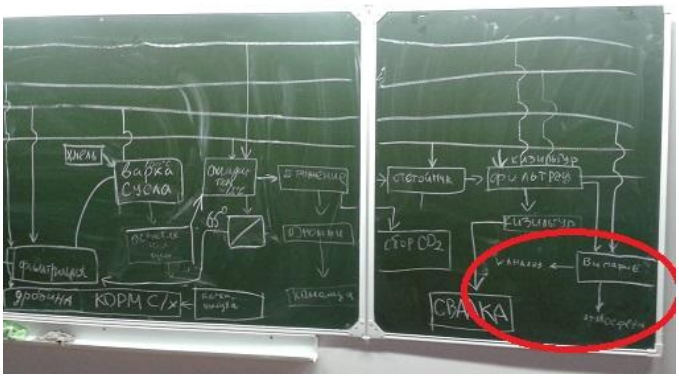

Fig. 2. The process of the production scheme's drawing and problem identification

It can be seen from Figure 3, that the specific consumption of technical water in 2012 per decilitre of beer produced in respect to the total monthly amount of beer produced is larger than in 2011. The average benchmark of two years is situated in between the linear trend lines of 2011 and 2012. That raises the question "What is the cause of such deterioration in resource consumption?" and allows proposing solutions for improvements.

After discussing the potential solutions in the class, students had to develop the proposed alternatives of the technological improvements further and carry out their technical and economic evaluation. Finally, students gave presentations on the assessment made. The results were discussed among students, teachers and representatives from the beer-producing company. All the interaction was made in Russian, thus efficiently overcoming the language barrier.

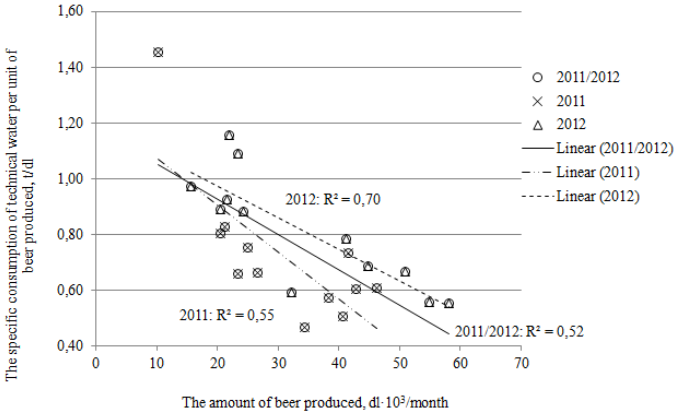

Fig. 3. The trends of the specific consumption of technical water depending on the monthly production of beer in 2011 and 2012

The Pilot training concept encompassed not only lectures and practical works for students, but also contributed to the dialogue between the three parties:

a) teachers (academic staff),
b) students, and
c) company representatives.

Figure 4 shows the algorithm of the method applied.

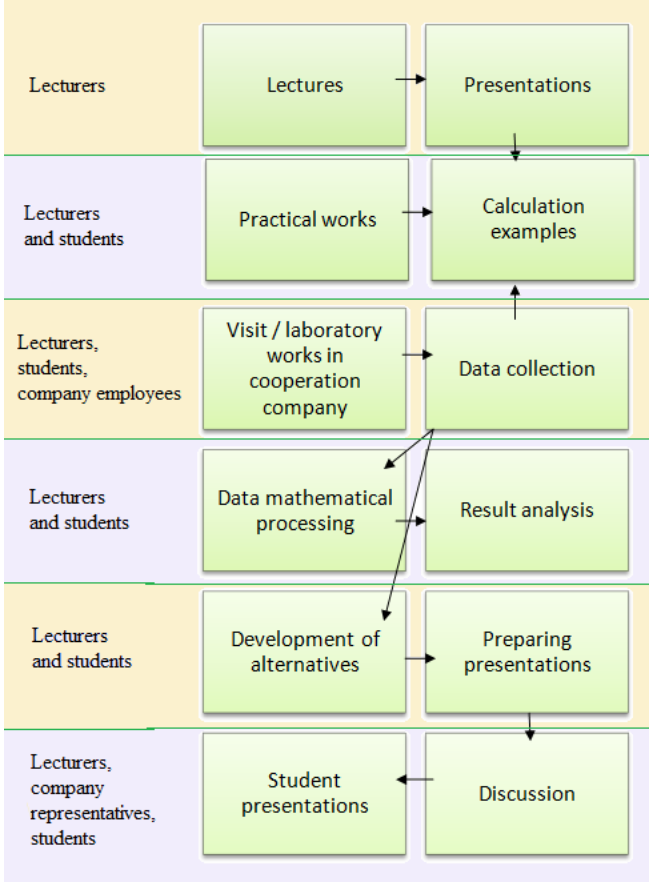

Fig. 4. Algorithm of the methodology

As the algorithm shows, the academic staff participates in the development and realization of every block. The main task is to create, develop and implement ideas, based on the results of the assessment and analysis carried out by students. The beer producing company representatives have a special role in the methodology applied. They provide the necessary data, introduce students and lecturers with the manufacturing processes and take active participation in the discussion of alternatives, thus demonstrating the real-application options of the ideas developed by students.

IV. Results

The Pilot training concept was practically verified in two Kazakhstan universities, i.e. A.Baitursynov Kostanay State University for master's degree students and Rudny Industrial Institute for bachelor's degree students. Riga Technical University represented Latvia which is a country formerly occupied by the Soviet Union. It was found that collaboration of academic staff from countries with a common past has many benefits when an innovative training concept is implemented:

1. sharing the story about the use of same or similar equipment and technologies;
2. improving awareness of opportunities and understanding of sustainable development;
3. sharing data processing and results' analysis practices and methods;
4. information and practical demonstration on the use of innovative teaching methods;
5. help in avoiding repetition of mistakes;
6. overcoming the language barrier (the use of Russian language allows better understanding and communication, thus learning/teaching the innovative technologies is more efficient).

A positive outcome was reached on the both sides of the involved participants – Latvia and Kazakhstan. The primary aim was to give students practical experience in critical assessment and problem solving at a real industrial site. The aim was reached, which is proved by the solutions for more efficient production processes that were developed by students. The improvements proposed and assessed included:

1. utilization of waste for biogas production;
2. installation of technologies for combined energy sources, e.g. solar, wind and gas to minimize the consumption of natural gas;
3. filtration and recycling of production wastewaters;
4. utilization of the emitted vaporized spirits for operating a Stirling engine for energy production;
5. installation of a combined heat and power unit to cover the production needs of heat and electricity;
6. installation of a water borehole;
7. production of alcohol from the evaporated spirit from beer;
8. installation of condenser in the boiler house; etc.

One of the most interesting ideas was a proposal for utilization of polluted kieselgur, a waste product of beer filtration processes. It was suggested as an additive in brick production to ensure higher porosity and greater thermal resistance. This illustrates systematic approach and understanding of student audience as well as the necessity to look for solution by expanding borders (outside the company).

The proposals for efficiency increase of the production process were discussed among professors, students and the beer production company's representatives. Figure 5 shows the range of interests of all the involved parties and their action directions. As it can be seen, solutions were proposed for all directions.

The additional positive result of the Pilot training was experience exchange between the academic staff of the involved universities. The Kazakhstan universities' staff was able to observe the training process and acquire new teaching methods. Whereas, staff of the Riga Technical University was able to verify the developed methodology of the Pilot training. Besides, follow-up for further cooperation in research and education were elaborated in the field of environmental engineering and renewable resources.

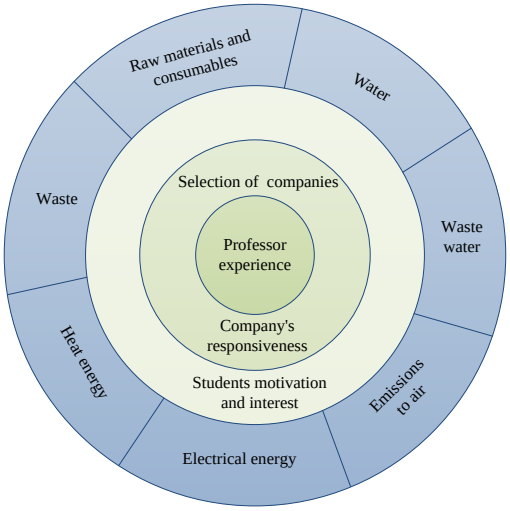

Fig. 5. Range of interests of the involved parties and their action directions

Finally, the visit of the beer production company and the company's positive responsiveness proved that there are potential cooperation possibilities between the industry and the higher education establishments.

V. Conclusions

1. When an innovative training methodology is implemented, a collaboration of academic staff from countries with a common past has several benefits as avoidance of mistake repetition, sharing knowledge of similar technologies and equipment, overcoming the language barrier in academic and scientific works etc. to name a few. It helps to acquire a better understanding of the situation and find more effective solutions in the academic, scientific and industrial spheres.

2. The methodology applied proved to be efficient to encourage the students' critical thinking skills allowing a further development of the environmental engineering curriculum in Post-Soviet countries.

3. Several positive effects of the academic experience exchange were achieved as widening the spectrum of teaching methods on the side of Kazakhstan universities and trials and affirmation of new training methodologies on the side of Riga Technical University. In addition, future cooperation options were identified on all levels – academic, scientific and industrial.

4. The verified training methodology can be applied in other Post-Soviet countries as well. It will allow transferring of European knowledge, experience and best practice to solve environmental engineering problems more effectively.

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Dagnija Blumberga, Dr.hab.sc.ing., professor, Riga Technical University, Institute of Energy Systems and Environment. Professor D. Blumberga has been part of academic staff of Faculty of Power and Electric Engineering, Riga Technical University since 1976 and director of Institute of Environmental Protection and Energy Systems since 1999. The main research area is renewable energy resources and environmental technologies. She has participated in different local and international projects related to energy and environment, as well as is author of more than 200 publications and 14 books. She has Thermal Engineer Diploma (1970) and two steps doctoral degree diploma. PhD thesis "Research of Heat and Mass Transfer in Gas Condensing Unit" was defended in Lithuanian Energy Institute, Kaunas (1988). Doctor Habilitus Thesis "Analysis of Energy Efficiency from Environmental, Economical and Management Aspects" was prepared in Royal Institute of Technology (KTH) Stockholm (1995) and was defended in Faculty of Energy and Electronics, Riga Technical University (1996).
Address: Kronvalda blvd. 1, LV-1010, Riga, Latvia
Phone: +371 67089908, Fax: +371 67089908
E-mail: dagnija.blumberga@rtu.lv

Elīna Dāce is a PhD candidate of environmental science at Riga Technical University. In 2009 she received master degree, but in 2007 – bachelor degree of environmental science.
At the moment E.Dāce is a researcher and lecturer in the Institute of Energy Systems and Environment, Riga Technical University. Her research interests are related to municipal waste management, source segregation of waste, waste to energy (refuse derived fuel) and landfill mining.
E.Dāce is a co-author of 30 scientific publications and 3 books. She is a member of the Association of Latvian Young Scientists.
Address: Kronvalda blvd. 1, LV-1010, Riga, Latvia
Phone: +371 67089923, Fax: +371 67089908
E-mail: elina.dace@rtu.lv

Jeļena Ziemele M.sc.ing., Riga Technical University, Riga International School of Economics and Business Administration (RISEBA). She has Master's degree in Thermal Technique and Master's degree in Business Administration. Graduated Environmental Science Master program in Institute of Environmental Protection and Energy Systems in 2013.
She worked in Academy of Science in Institute of Microbiology as a Science Assistant, JSC 'Ligija Teks' as the Manager of Boiler and Turbine House,

JSC 'Latvijas Gāze' as a Main Engineer.
At the moment she is researching energy saving technologies and environmentally friendly solutions. She is a PhD student of environmental science at Riga Technical University.
Address: Kronvalda blvd. 1, LV-1010, Riga, Latvia
Phone: +371 67089923, Fax: +371 67089908
E-mail: jelena.ziemele@rtu.lv

Igor Koshkin is a docent at A.Baitursynov Kostanay State University. He has 16 years' experience of scientific and academic work. In 2008, I.Koshkin defended his PhD candidate thesis. He is a co-author of more than 25 scientific papers published in scientific journals and conference proceedings. He is an author of two manuals.
I.Koshkin's scientific interests are related to power production, energetics, power grids, renewable energy sources and eco-engineering.
Address: Abaya Street 28/3 – 324, 110000, Kostanay, Kazakhstan
E-mail: elektroenergetika@mail.ru

Zauresh Habdullina is a professor at Rudny Industrial Institute, Faculty of Electrical Engineering and Information Systems. Z.Habdullina is the head of the Institute of Power and Heat Energy.
Address: 50 Let Oktobra Street 38, 111500, Rudny, Kazakhstan.
E-mail: habdullina@rii.kz