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Integration of climate change issues in engineering sciences
Klimata jautājumu integrācija inženierzinātnēs

Education on climate change (CC) is one of the important aspects for implementation of sustainable development concept into everyday practices in universities. At the same time the way how to discuss different aspects of the CC problems is different depending on the type of study program and approaches used at the development of study curricula. In this study the approach for integration of CC issues in engineering sciences used in Riga Technical University is discussed.

The requirements towards education on CC issues can be structured according to the following levels:

1. Level. General information about the climate change;
2. Level. General information about the climate change and its consequences;
3. Level. Understanding the social responsibility and the need for mitigation and adaptation to CC;
4. Level. In depth basic studies of CC, including modelling, studies of impacts at local and regional level;
5. Level. Expert level – consulting, participation in Kyoto flexible mechanisms: emission trading and joint implementation schemes.

Despite the relatively wide information provided in mass media and some aspects of the CC problematic discussed at the school, still at the university level is evident need to give systematic and systemic information on CC (1, 2 level of the CC education). Third to Fifth levels can be related to training of experts (specialisation and requires of allocation of significant space in the study programs or even specialisation at higher study level in CC). Key components are management and decision making skills which allow achieving aims of the climate change education.

Presently in Latvia degree in environmental science at B.Sc., M.Sc. and PhD level can be obtained in Riga Technical University and University of Latvia. In Riga Technical University the education has strong emphasis on energy production, energy saving and climate technologies.

The education on climate change in Riga Technical University is done using the so called “dispersed climate change study approach” (see Figure 1). This approach includes use of modular course structure. Each of the study courses is dealing with a separate aspect of climate change, but together each module serves to deliver specific aspect of the climate change, but all together the study program provides general view with specific aspects on the issue.

Module “A” includes traditional environmental science study topics (Environmental policy and economics, Environmental technologies, Cleaner production, Energy technologies, Environmental Protection problems), as well as freely electives (Environmental impact assessment, Life cycle analysis and others).

Module “B” includes not only traditional study forms, during practical classes doing independent studies, calculations, audits of enterprises, but also using games as tools of studies. A special place is allocated for engineering aspects of the emission trading and flexible mechanisms in this respect. For example, during the study course “Cleaner production” audit of eco- and energy efficiency of enterprises is done and students are attempting to give recommendations for an enterprise how to increase efficiency of production at the same time increasing efficiency of the production. In the module “B” also study course work is of major importance as far as during this stage of the study process students gain necessary practical skills.

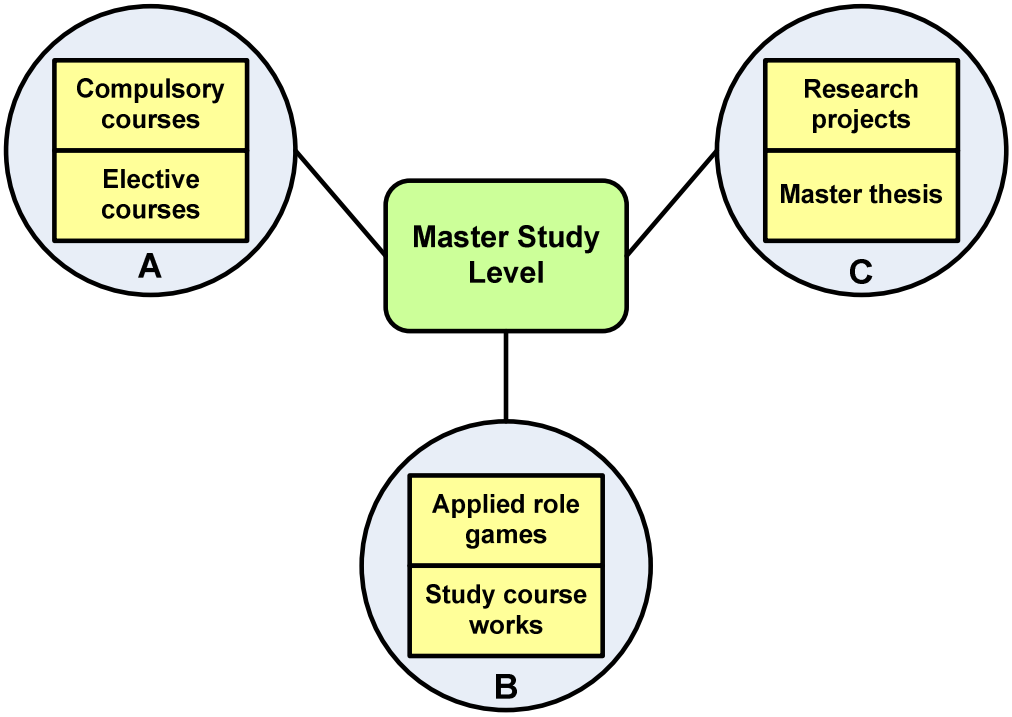

Figure 1.Dispersed climate change study approach in Riga Technical University

Module “C” involves deeper studies on problems actual in Latvia or in neighbouring countries. The students have possibility to involve in solution of actual problems in enterprises. Possibilities to participate in research projects and cooperation between state authorities and academia also is of importance. For example, students actively participate in the elaboration of Riga Technical University energy efficiency improvement and renewable energy resources development midterm (2010-2020-2030) strategy and action plans which are based on development of climate technologies in Latvia.

Case study – example for activity in Module “B”

Every year new creative ideas are added to Module “B”. Those ideas result from scientific research projects, for example, during the elaboration of sustainable energy sector development scenarios it was concluded that Latvia is able to reduce the greenhouse gas emissions from energy generation sources by 2 million tCO_2/year in case if crucial changes in means of replacing fossil fuels with renewable energy sources is done. In order to find solutions to promote the use of available wood fuel resources, joint discussion among master and PhD program students were organized. The title of discussion was “Latvia has wood. Why don’t we use it sufficiently?” The discussion was organized in two parts:

1) Vertical part of discussion
    a. Introduction to problem. Discussion objectives and tasks. The role of each participant;
    b. Available wood amounts in Latvia – overview on research results. Obtained data and their reliability;
    c. Technical solutions for use of energy wood: from small appliances to large boilers in CHP plant;
    d. How is it possible for Latvia to reach the targets set by Energy and Climate Package of European Union? Forecasts;
    e. CC aspects of the use of energy wood. Kyoto flexible mechanisms.

2) Horizontal part of discussion. Explanations on thematic tables:
    a. Legislation issues and solutions;
    b. Engineer-technical issues of implementation of wood fuel use;
    c. Economical and financial issues and solutions;
    d. Awareness raising and the role of education;
    e. CC and environmental aspects.

All participants were divided in 5 groups and every 15 minutes were changing the discussion table. Each discussion table has the leader that listened to all discussion participants and summarized opinions on each problem. Discussion participants were listening to thematic table conceptions and ideas what should be done in energy sector to reduce the impact on CC. The final discussion resulted to clarifications and additional ideas. Discussion results were published on web-site and sent to the Ministry of Environment and Ministry of Economy.

The results of discussion are multipurpose. Master and PhD study programs are developing through technological solutions to the direction of CC mitigation. The government receives creative ideas for CC impact reduction. In CC study courses, the learning process is improved with training on job methods. Emotionally the self-confidence of academicals staff and students involved in implementation of environmental studies is increasing.

The role of CC issues in environmental engineering study program in future

Introduction of Kyoto flexible mechanisms is giving the chance for additional scientific research regarding joint implementation and emission trading programme possibilities and directions. The government of Latvia have decided to introduce the Green Investment Scheme where the first period will be in 2009-2012 and following the second one until 2020. Consequently this is giving the opportunity to introduce changes in environmental science studies where during the practical works it is necessary to make more emphasis on analysis of potential greenhouse gas emission reduction projects, their implementation process and monitoring of obtained results.

The analysis of GHG emission reduction results and dissemination of practices examples is necessary not only for students in class room, but as well as for the development of Latvian economy.

The integration of CC issues in engineering studies on long term is providing the bases for three important principles for education on CC: increased importance of scientific research,

improvement of methods for analysis and implementation of system thinking approach, and increased cooperation among all levels.

In Riga Technical University scientific research will be continued on the following climate technology areas: life cycle analysis of bio-hydrogen production by use of photosynthesis and fermentation, simulation of CO_2 capture and underground storage, increase of share of renewable energy sources in Latvia etc. The use of renewable energy resources is an issue that is important both on national and local level, however this is not an issue that one can solve without analysing it within the context of national development.

The same could be related to the education on CC issues. Next to the life cycle assessment that gives an answer to evaluation of anthropogenic impact on climate change, the new concept of system analysis should be introduced in environmental study programs by using the systemic approach to for solving the CC problems and finding explanations.