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INTEGRATION OF SUSTAINABILITY PRINCIPLES IN CURRICULUM OF CIVIL ENGINEERING AND ARCHITECTURE SPECIALIZATION

V. I. Bolshakov, Dr. Sc. (Tec , Professor, postmaster@mail.pgasa.dp.ua,
M. V. Savitskyi, Dr. Sc. (Tec , Professor, sav15@ukr.net,
M. M. Babenko, Ph. D (Tec , Doctoral Student, babenko.marina@yahoo.com,
SHEI «Prydneprovs`ka State Academy of Civil Engineering and Architecture»

The examples and perspectives of the integration of sustainability principles in curriculum are discussed. The reformation of disciplines according to these principles in building sector for civil engineering and architecture education is considered.

Keywords: sustainable development, green architecture and structures, curriculum transformation, distance learning, urban-planning study.

Statement of problem. The term «sustainable development» became prominent after the Rio Earth Summit in 1992 which prioritized global environmental discussions and improved upon the initial framework introduced at he United Nations Conference on the Human Environment, Stockholm in 1972. The resulting Rio Declaration on Environment and Development, however, advocated the role of education in preventing ecological degradation (Cleveland & Kubiszewski, 2007). There are many definitions of the term «sustainable develop-

ment», but the most widely accepted is the one used in the publication «Our Common Future», sometimes referred to as the Brundtland definition: «Development which meets the needs of the current generation without compromising the ability of future generations to meet their needs»(UN, 1989) [1].

Environmentalists and researchers were faced the challenge of the definition of the main bases of the sustainable development theory. In an attempt to address these, a variety of models and frameworks were created. The priority areas in sustainable development have been identified, as well as ways to achieve progress by identifying economic, social and environmental goals.

Progressively, universities and other higher education institutions (HEIs) have been incorporating sustainable development values and practices into their core activities of teaching and research, institutional management and operational systems. However, the debate thus far has focused primarily on the rationale and reasoning for why sustainable development needs broad adoption. The international discussion, however, has failed to specify the various actions that higher education institutions can adopt, especially taking into account different possibilities and basic conditions of the institutions.

For Ukrainian higher education the question of greening the curriculum and sustainable development adaptation is still quite new. The unique experience gained by the participation in the international projects gives the general understanding of the actuality of reformation the curriculums according to the modern tendency in all study fields of sustainability principles following as well as the possible ways of green standards large scale adaptation. While the national principles of achieving this goal is not under the consideration in the government level.

Representatives of building sector is interested in the new generation of specialist who are ready to solve the contemporary tasks of life cycle optimized design demanded by the market. The higher education should look for ways not only of adaptation of world wide accepted theoretical principles but also guaranty the preparation of the qualified modern specialists. Additionally, *civil engineering and architecture put in the real form the principles of sustainable development by the production of energy-efficient, ecological, economical-efficient and social adapted buildings.*

Analysis of recent papers. National Strategy for Development of Education in Ukraine for 2012–2021 years [2] includes the general declaration of the adaptation of the principles of the sustainable development principles but the development of any detailed mechanism of its adaptation for the civil engineering and architecture specialization are not mentioned.

Aim of the paper. The aim of the paper is to present the experience of the elements of sustainable development integration in civil engineering and architecture education and the elaboration of universalized basis of its large scale implementation in other establishments.

The article discusses the reformation of curriculum according to the sustainability standards in the term of rationalization of economic, environmental and social components. In application to the civil engineering and architecture specialization each of these components should be integrated for each stage of building life cycle study, thus for the following courses and education disciplines - Fig. 1.

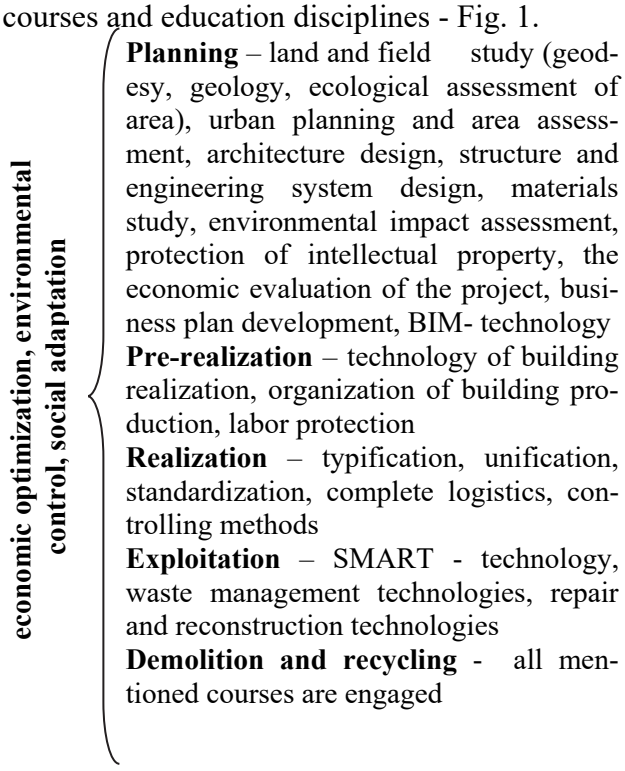

Fig. 1. Rationalization of economic, environmental and social components in application to the civil engineering and architecture specialization

Consequently, almost each specialized course is supposed to include elements (lectures) of sustainability theory. *Social-humanitarian and economic complex of disciplines are considered as supportive* giving the basic understanding of the conception which should be adapted and integrated during the study of main disciplines.

The weak part of the existing curriculums in Ukraine is that they are mostly based on the theoretical case studies what are especially not effective for the civil engineering and architecture specialization education. That`s why in joint international projects Prydneprovs`ka State Academy (PSACEA) has focused on the modernization of curriculum by the large-scale integration and analyzation of real-life examples together with realization the projects taking into account real conditions and real tasks.

PSACEA experience in integration of sustainability aspects in curriculum.

ECO-Campus platform of distance learning. Since in December 2014, in cooperation with the Brandenburg Technical University (Cottbus, Germany), National Mining University NMU (Dnipro), with the assistance of GIZ and DAAD an active scientific work is proceeding in the field of ecological building and sustainable development in the construction, restoration of cultural heritage, planning areas.

The list of the results of this cooperation includes PSACEA participation in the first international scientific and practical Internet-conference «Management, Marketing, Entrepreneurship: promoting sustainable development» (December 2014), as well as in the unique for Ukraine International Summer school «Greening of curricula and programs - Integrate aspects of sustainable development in the university education» (07-18 September 2015).

Winter 2016, the tripartite cooperation agreement BTU-Cottbus-Senftenberg (Department of Environmental Planning) – GIZ – PSACEA (Faculty CIE) was signed, in the context of greening educational programs, introducing of the distance learning platform Eco-Campus. The first group of PSACEA students have passed the course and received certificates and in the diploma supplement was an article about the course, a delegation of teachers participated in the workshop based on the system BTU Eco-Campus.

The aim of the ECO-Campus is the establishment of a university scientific and education network, which is carried out by GIZ and the Brandenburg Technical University of Cottbus-Senftenberg (BTUCS). Selected partner universities from the Ukraine, Cameroon, Vietnam, Lebanon and Peru will be among the founding members of the network.

The ECO-Campus aims to incorporate the concept of sustainable resource management into the learning outcomes and curricula of universities and educational institutions across disciplines as an interdisciplinary topic in terms of the Green Curriculum. In addition to basic tools such as project-related environmental impact assessment and strategic environmental assessment of plans and programs which by now are standard elements of the environmental legislation in many countries, concepts and methodological approaches such as Life Cycle Assessment, Voluntary Sustainability Standards or corporate social responsibility (CSR) become increasingly important components of sustainable development.

ECO-Campus provides the technical platform for the assembly and cooperation of universities who share a common goal: the stronger integration of the subject sustainability into their curricula. Based on an internationally popular open source software solution (Moodle), the contents of the server-based e-learning platform will be made available soon. Thus ECO-campus acts as a central communication and learning platform via which the different materials are provided. Furthermore, Eco-Campus thereby sets the basis for the Green Curriculum with the option to integrate other disciplines that pursue environmentally and socially sustainable thinking, planning, action and decision making, into the curriculum. [3]

TEMPUS project Regional Sustainable Development on the Basis of Eco-Human Synergetic Interaction (SEHSI). The project is focused on the development of innovative curriculum for training new generation of engineers as «agents of positive changes» in regional development based on synergetic eco-human interaction and advanced technologies.

Project «Regional sustainable development on the basis of eco-human synergetic interaction (multidisciplinary training course for

MSc, PhD students in engineering)» – SEHSI is aimed at providing positive changes in regional sustainable development (RSD) based on cognitive and personality growth of «agents of positive changes» by developing eco-humanistic knowledge, thinking & behavior. Specific project objectives are: 1) creating RSD multidisciplinary curricula for students in engineering; 2) integrating e-learning & advanced infrastructure for amplifying UA universities training capacity; 3) developing academic-industrial-business–governmental RSD network. The following outputs & outcomes are expected: 1) human resources (25 trainers) development on the basis of RSD competence profiles within training of the trainers' program at EU institutions; 2) training resources development: RSD methodology (synergetic cognitive-personality development of students within engineering training process), curricula (8 modules of 120 ECTS based on metacognitive, professional, communicative competences profile); training packages (30 RSD course books, CD with RSD lectures in PP format, CD with e-tests & inventories for RSD course evaluation & self-control); 3) e-training resources development: RSD e-training package (30 RSD e-books, platforms providing environment for training & multidisciplinary multinational project teamwork; self-developing database of RSD training materials); SEHSI e-net integrating training-dissemination-management activities (RSD training e-center, management e-center, e-expo center); 4) 200 MSc, PhD and LLL students in engineering trained within RSD pilot training; 5-8) SEHSI resources development for evaluation (methodology, e-tools, 15 evaluations), dissemination (methodology, project site, e-expo center, 26 events), sustainability (RSD network, database, course accreditation, financial plan); management (strategy, e-database & e-center) [4].

The project addresses in relation to Ukraine: Curriculum reform: modernization of curriculum with 3 cycle structure, ECTS & degree recognition in the subject area of Engineering and engineering trades. Proposal of developing curriculum for training MSc, PhD, LLL students of engineering in RSD is directly related to UA policy of reforming national education for the integration into European education space. System development of human training, e-training resources & advanced infrastructure are aimed at amplifying UA universities training capacity. National priorities of development quality introduction, partnership with enterprises, LLL & qualification framework are also present.

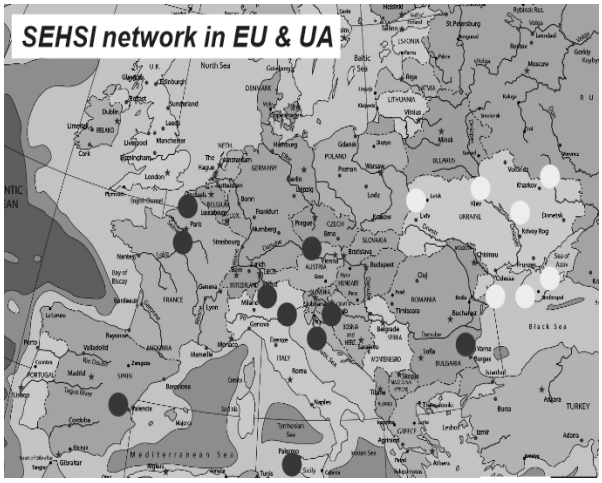

Fig. 2. SEHSI network in EU and UA

The project officially finished in October 2016, the results are summarized.

New course of Green buildings for Master and PhD Students. On the based of achieved experience and knowledge as the result of realized international projects the new courses have been integrated in the curricula of PSACEA. One of the complex courses is the course of Green buildings for Master and PhD Students proposed in the department of reinforced concrete and masonry structures of PSACEA.

The develloped course proposes complex knowledge in the field of rational structure design taking into main consideration the sustainable development principles. It widely uses the real case studies and propose to solve real-life industrial tasks. For now, course is proposed as the part of Master's and PhD students preparation.

The success of the educational process is possible only in close connection with the research and technology transfer in the business environment. The integration of sustainable development principles in the components of «science – education – production» is ensured in PSACEA through the activities of the established scientific and educational structures – Ukrainian national center of ecological architecture and green building, R&D center of international scientific projects and programs.

With the participation of masters students, graduate students, doctoral students the research on sustainable development are conducted, financed by the Ministry of Education and Science of Ukraine and from the other sources. There have been prepared a number of projects for participation within the program Horizon 2020. As a result of research, the number of Master's, PhD and doctoral dissertations, monographs have been published [5, 6].

Table 1

General scheme of GREEN Building course integrated in PSACEA

PhD	**Master**	Sustainable development – general conception (theory)
		Bases of sustainability implementation in construction (theory+practice)
		Green building standardization (theory+practice)
		Sustainable urban planning (theory+practice(arch))
		Engineering systems for sustainable construction design, rational energy-efficiency ensurance (theory+practice)
		Green economy and circular economy implementation for sustainable construction design (theory+practice)
		Social aspects for sustainable construction design including heritage reservation and specific design for people with special needs (theory+practice)
		Interdisciplinary aspects of sustainable development

Conclusion.

1. Modernization of curriculum is a continuous process, but now Ukrainian higher education is faced the big challenge of integration of the sustainable development concept aspects in each discipline to provide the effective preparation of modern specialists.

2. Construction sector is the one, which put sustainability principles in a real form needs new experienced specialist capable to evaluate the whole life cycle of the building, and take correct decision concerning its form and content.

3. Today, Ukrainian higher education establishment mostly rely on personal experience gained in the international project to reform the curriculum, while there is a need to establish multidisciplinary cooperation to elaborate universalized common strategy to integrate the sustainable development principles in Ukrainian civil engineering and architecture education.

4. PSACEA experience of greening curriculum, demonstrated in the paper, has shown the potential of its dissemination.

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ІНТЕГРАЦІЯ ПРИНЦИПІВ СТАЛОГО РОЗВИТКУ У НАВЧАЛЬНІ ПРОГРАМИ СПЕЦІАЛІЗАЦІЇ «ЦИВІЛЬНА ІНЖЕНЕРІЯ ТА АРХІТЕКТУРА»

В. І. Большаков, д. т. н., професор, М. В. Савицький, д. т. н., професор,
М. М. Бабенко, к. т. н., докторант,
ДВНЗ «Придніпровська державна академія будівництва та архітектури»

У статті розглянуто перспективи інтеграції принципів сталого розвитку в навчальні програми, а також напрями реформування дисциплін відповідно до цих принципів в навчальних закладах, що готують спеціалістів для будівельної галузі за напрямками «цивільне будівництво» і «архітектура».

Ключові слова: сталий розвиток, зелена архітектура і конструкції, трансформація навчальних програм, дистанційне навчання, міське планування.

ИНТЕГРАЦИЯ ПРИНЦИПОВ УСТОЙЧИВОГО РАЗВИТИЯ В УЧЕБНЫЕ ПРОГРАММЫ СПЕЦИАЛИЗАЦИИ «ГРАЖДАНСКАЯ ИНЖЕНЕРИЯ И АРХИТЕКТУРА»

В. И. Большаков, д. т. н., профессор, М. В. Савицкий, д. т. н., профессор,
М. М. Бабенко, к. т. н., докторант,
ГВУЗ «Приднепровская государственная академия строительства и архитектуры»

В статье рассмотрены перспективы интеграции принципов устойчивого развития в учебные программы, а также направления реформирования дисциплин в соответствии с этими принципами в учебных заведениях, которые готовят специалистов для строительной отрасли по направлениям «гражданское строительство» и «архитектура».

Ключевые слова: устойчивое развитие, зеленая архитектура и конструкции, трансформация учебных программ, дистанционное обучение, городское планирование.

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