St. Per.

ISSN 1897-9262

Studia Periegetica

WYDAWNICTWO
WYŻSZEJ SZKOŁY
BANKOWEJ

Studia Periegetica nr 3(23)/2018

Promoting Education for Sustainable Development in Higher Education

Studia Periegetica nr 3(23)/2018

Promowanie edukacji na rzecz zrównoważonego rozwoju w szkolnictwie wyższym

redaktor naukowy

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Wydawnictwo
Wyższej Szkoły Bankowej w Poznaniu

Poznań 2018

Studia Periegetica No. 3(23)/2018

Promoting Education for Sustainable Development in Higher Education

volume editor

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The WSB University in Poznan Press

Poznań 2018

Publikacja finansowana przez Wyższą Szkołę Bankową w Poznaniu
Publication financed by the WSB University in Poznań

Wersja pierwotna – publikacja drukowana / Source version – print publication
Nakład: 150 egz. / Circulation: 150 copies

ISSN 1897-9262

Wydawnictwo Wyższej Szkoły Bankowej w Poznaniu
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Druk i oprawa / Printed and bound by Zakład Poligraficzny Moś i Łuczak, Poznań

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Introduction

To quote UNESCO's publication "Rethinking Education. Towards a global common good?" from 2015: "Education can, and must, contribute to a new vision of sustainable global development."

Quality education is goal number 4 of the UN Sustainable Development Goals.[1] Education has the power to make changes, and a key role in promoting improvements for most of the other Sustainable Development Goals. Education for Sustainable Development (ESD) is a valuable change-maker by providing knowledge, skills, values and attitudes from an early stage in the education system. The responsibility of the education system is to define learning objectives and content on a relevant level.[2] Therefore, it is of importance to provide both learners and teachers with up-to-date scientific facts and learning methods in order to achieve an education of high quality according to sustainable development.

Learning for sustainable development addresses the classic didactic questions: what to learn, how to learn it and why. Skills for sustainable development focus on learning in terms of critical thinking, problem solving, collaboration and creativity. I.e. in line with the 21st Century Skills.[3] The challenges for higher education concerning questions of sustainable development are the paradoxes of categorizing and specializing knowledge and skills versus working according to a more interdisciplinary and holistic approach.

To direct higher education towards a more sustainable mindset, the organizational culture needs to change. The process has started, but still much needs to be done. Roxå and Mårtensson[4] have divided the response of the leader trying to

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[1] www.un.org/sustainabledevelopment/sustainable-development-goals/ [access: 13.12.2018].

[2] UNESCO, Education for Sustainable Development Goals. Learning Objectives, Paris 2017.

[3] www.aeseducation.com/careercenter21/what-are-21st-century-skills [access: 13.12.2018].

[4] T. Roxå, K. Mårtensson, How leaders can influence higher education cultures, *Perspectives on Pedagogy and Practice*, 2013, 4, 1-21.

reform the system into four dimensions depending on the level of involvement and the mindset of its members. Some of them are actively engaged in promoting a change, but there is also a group of those who hold quite opposing views and are actively working against the change. A big majority of people in organizations is either in favour or against the change in the system, but remains more or less passive and is effectively neutral. This big silent majority is the key for making changes. This group should be invited to an open communication about teaching and learning. As Roxå and Mårtensson[5] state, the leader does not control the culture of an organization; the culture controls the leader.

The university network working as part of the Baltic University Programme,[6] BUP, organizes courses for students, PhD students and teachers in higher education. During the academic year 2017-2018, BUP organized the first course named "Education for Sustainable Development in Higher Education." The aim of the course was to support university teachers within the BUP network in their efforts to integrate the UN Sustainable Development Goals in their practical work as teachers in the Baltic Sea Region.

The course consisted of five cycles. The first cycle was an e-learning component. The participants were introduced to the concept of sustainability and the EDS. Cycles 2 and 4 featured face-to-face workshops including lectures, methods and workshops. Cycle 3 was an individual, or pair work, in the so-called change project. The work included planning, development, presentation, feedback, and peer reviews. The change project was a course or study program at the home university where the participants propose changes in an existing curriculum to better meet the needs of sustainable development. The last, fifth, cycle was a post course work aimed at implementing the change project at the home university. The participants also had an opportunity to publish their results and outcomes in the form of a peer-reviewed scientific publication. This issue of *Studia Periegetica* is the outcome of this effort. These seven articles represent good examples of a range of pluralistic methods of student-centered and activating learning methods. They also highlight knowledge gaps and suggestions as topics to focus on in the nearby future.

The overall feedback of the course was very positive. The content was diverse including facts, learning methods, personal involvement in form of the change project, as well as sharing of knowledge, skills, and networking between the approximately 25 participants from nine countries in the Baltic Sea drainage area. A similar course is running now, starting in the autumn 2018 and will end in the spring of 2019.

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[5] Ibidem.

[6] www.balticuniv.uu.se/ [access: 13.12.2018].

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DOI: 10.26349/st.per.0023.01

Nadiya Kostyuchenko*, Denys Smolennikov**

Education for Sustainable Development through Teacher Training

Abstract. The paper is dedicated to the idea of a change project in a higher educational establishment. The aim of the change project is to promote education for sustainable development through teacher training while including sustainable development issues in the teacher training program focusing on active learning techniques. The paper describes actions towards the change project with concrete steps. It includes a detailed description of the five cycles of the change project together with value creation stories (immediate value, potential value, applied value, realized value, and reframing value).

Keywords: education, sustainable development, sustainable development goals, teacher training, active learning, change project

1. Introduction

Nowadays universities are increasingly facing the problem of outdated teaching techniques applied in educational process and the low motivation of students attending traditional face-to-face classes. At the same time, with the widespread use of massive open online courses and e-learning, students have an alternative to traditional classes, which involves studying at home. The modern system of

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teacher training should be not so much highly specialized but should help young and already experienced teachers to create modern, appealing content and develop students' competencies for the 21st century. The emphasis should be placed on active teaching techniques, blended learning and education for sustainable development.

Many scholars around the world agree that teacher training programs should be modernized. One of the most popular approaches is to provide competency-based education that should focus on key competencies needed in real life (critical and systemic thinking, lifelong learning competence, problem-based curricula, etc.) [Serdenciuc 2013: 757]. Moreover, teacher training as a kind of lifelong learning is a key factor for development and growth of countries [Aleandri & Refrigeri 2014: 547].

Some researchers have tried to evaluate the effectiveness of teacher training programs [Ciraso 2012: 1778] in terms of different factors, such as transfer motivators, school climate, organizational structure change, personal implication, willingness to change, and relationship with educative administration. Buchberger et al [Buchberger et al. 2000: 40] indicated three main results of effective teacher training: teachers acquire the ability to establish a powerful learning environment, transform academic knowledge into teaching and learning situations, and provide co-operative problem-solving and teamwork.

According to Morgen, Gericke and Scherp [2018: 18], the effectiveness of schools that implement the education for sustainable development strategy is higher than in other schools. This is especially true with respect to pluralism, collegial learning and student-centred approaches.

Sinakou et al. [2018] state that the inclusion of a course focusing on education for sustainable development in teacher training is almost a single opportunity for teachers to study the concept of sustainable development systematically and transfer this knowledge to students.

The study of Annan-Diab and Molinari [2018: 9] indicates that a interdisciplinary approach in education for sustainable development is extremely important, because it encourages students to combine knowledge from different disciplines to study sustainable development issues. A similar opinion is expressed in the study by Nasibulina [2015: 1081], where education for sustainable development is characterized as "vertical" education because it penetrates all levels of education. Major et al. [2017] propose the idea of creating an efficient educational institution that will teach sustainability issues for teachers. As a result, future teachers will be able to apply various methods in practice and prepare students for different global challenges.

2. Background: current situation on teacher training in Ukraine and at Sumy State University

According to the requirements set out by the Ukrainian Ministry of Education and Science, teacher training is obligatory for every teacher in the country during a five-year period of time. This means every teacher has to attend a teacher training program suited to their pedagogical and scientific interests. Such a program has to be worth no less than 3 ECTS credits, and usually lasts 1-2 months.

There are several established teacher training programs currently available at Sumy State University (Ukraine), including one devoted to e-learning techniques, and another one on innovative pedagogy. At the moment there is no teacher training program and few student courses interrelated to sustainable development issues at Sumy State University and none that is dedicated to education for sustainability. Existing teacher training programs are out-of-date and mostly feature traditional teaching methods.

2.1. The idea of a change project

The purpose of a change project is to develop a teacher training program that focuses on active learning techniques and to include sustainable development issues as a key aspect of the content. The new teacher training program will be titled "Active learning techniques for education for sustainable development."

The aim of the change project is to promote education for sustainable development through teacher training.

The project is addressed to teachers from Sumy State University and other Ukrainian educational establishments.

Expected outcomes of the change project include:

– increased teachers' awareness on sustainable development issues;

– dissemination of the idea of sustainable development among teachers and students;

– expanding the idea of sustainable development and sustainable development goals in teachers' pedagogical practice through active learning techniques.

2.2. Actions towards the change project

Several steps have already been taken to implement the change project.

STEP 1. New teacher training program in active learning techniques

The new teacher training program in active learning techniques was successfully launched at Sumy State University in November 2016, but it did not include any sustainable development issues at that time.

The first two rounds of the teacher training program in active learning techniques were run during November 2016 and October-November 2017.

The teacher training program in active learning techniques included several components:

- lifelong learning;
- e-learning and blended learning;
- problem-based learning;
- project approach in education;
- gamification in education;
- mobile devices used in study process, etc. [Kostyuchenko 2017b: 19-20].

Active learning techniques were chosen to be used as teaching methods for the new teacher training program. The following techniques were considered to be the most effective ones for implementing a modified educational program:

- case-studies;
- flipped classroom technique;
- debates;
- simulation games;
- "world café";
- open space;
- "think, pair, share" strategy;
- pitching, etc. [Kostyuchenko & Smolennikov 2016: 146-151].

The brochure "Innovative Green Teaching. Primer on innovative teaching techniques of environmental and energy topics" [Ebers et al. 2017] was used as a source of guidelines for planning classes. It included numerous links to different examples of active learning techniques applied to sustainability issues. The brochure was created by teachers from Sumy State University (Ukraine), University of St.Gallen (Switzerland), and University of Tartu (Estonia) and was published in December 2017 as a result of the SCOPES project funded by the Swiss National Science Foundation. The brochure includes such sections as: blended learning, flipped classroom, case study, public debates, pitching competition, visual thinking: infographics and mind maps, video and audio, Model UN and other simulations, educational business games, etc.

Additionally, some case-studies presented during the Baltic University Program Teachers' Course on Education for Sustainable Development in Higher Education were also useful for the new teacher training program.

The teacher training program in active learning techniques is currently under revision. Education for sustainable development is planned to be implemented into the program as a key component. The new teacher training program

is planned to start in October 2018 when the next round of teacher training at Sumy State University starts.

STEP 2. Venue for the change project

In November 2016 a creative educational space called IdeaLab was founded at Sumy State University under the Swiss-Ukrainian-Estonian institutional partnership project of the Scientific Cooperation between Eastern Europe and Switzerland (SCOPES) # IZ74Z0_160564/1. The interior of the room was jointly designed by students and teachers and therefore, the room became an inspiring place both for students and teachers to try new methods of study [Kostyuchenko 2017a: 16].

There was no doubt when choosing a venue for the change project. The IdeaLab was found to fit the purpose perfectly. The room was additionally decorated with some inspiring pictures as well as some basic information on sustainable development issues.

Sumy State University has been cooperating with UNDP as part of the "Community-based approach to local development" since 2010. The UNDP project provided some posters and other information materials that were used to create the proper environment for learning sustainable development issues at the IdeaLab.

STEP 3. Baltic University Program teachers' course

Several teachers from Sumy State University took part in the Baltic University Program Teachers' Course on Education for Sustainable Development in Higher Education during the period of 15 September 2017 – 31 March 2018. The 7-month course was run by the Centre of Lifelong Learning (Åbo Academi University, Finland) in cooperation with the Swedish International Centre on Education for Sustainable Development (Sweden).

The aim of the course was to support university teachers in their efforts to integrate education for sustainable development in teaching and courses/programs, to strengthen the implementation of the United Nations Development Goals through creating and implementing a change project at the home university.

The Teachers' Course on Education for Sustainable Development in Higher Education included several e-learning sections, such as "Introduction to sustainability" and "Climate change" via the Moodle distance education platform, as well as face-to-face workshops on "Sustainable development issues" and "Education for sustainable development methodology". Different learning methods were introduced during the course, mostly focusing on e-learning techniques, peer learning and face-to-face training.

The idea of the change project became clear and feasible as a result of the Baltic University Program Teachers' Course on Education for Sustainable Development in Higher Education.

STEP 4. Workshop on Sustainable Development

A two-day workshop for teachers was held at Sumy State University on 2-3 November 2017. The workshop was dedicated to sustainable development goals (SDGs) and was organized in cooperation with UNDP "Community-based approach to local development". The quiz "How much do you know about the SDGs?" [www.17goals.org/quiz-level-1/] was held at the beginning of the workshop to measure teachers' awareness of sustainable development. The results of the quiz showed that the majority of teachers from Sumy State University were familiar with SDGs but did not know the details.

Representatives of UNDP "Community-based approach to local development" presented 17 SDGs cubes to Sumy State University to visualize the ideas of the workshop. The SDGs cubes are currently kept in the IdeaLab and provide a good visualization of sustainable development issues for both teachers and students coming to creative educational space for different activities and events.

A study tour of the innovative factory "Kobzarenko Plant" (which manufactures agricultural equipment [www.kobzarenko.com.ua/about_en.html]) was held on the second day of the workshop – 3 November 2017. Teachers attending the workshop had a unique opportunity to see practical issues of energy efficient technologies (alternative electric and heating systems, recycling, etc.).

STEP 5: Identification of supporters

Another challenge was to identify supporters, i.e. colleagues who support the idea and are ready to help as members of the team. It is almost impossible to make changes alone, that is why the idea of the change project was disseminated between colleagues from Sumy State University who were already using active learning techniques in their teaching practice, and those ready for changes. As a result, strong support for the change project was found from several young teachers.

2.3. Change project value creation story

The value created by the change project was identified based on the framework provided by Wenger et al. [Wenger, Trayner & de Laat 2011]. Education for sustainable development through teacher training created different types of value, which could be described in five cycles.

CYCLE 1: Immediate value

Immediate value was created as a result of participation of several teachers from Sumy State University in the Baltic University Program Teachers' Course on Education for Sustainable Development in Higher Education. Immediate value included:

– deeper knowledge of sustainable development and education for sustainable development;

– new knowledge of the design thinking method, critical thinking technique and circular economy approach;

– new skills and experience of working with Moodle;

– the creation of a new network of change-makers in higher education.

The new network inspired changes, and the new knowledge and skills acquired during the teachers' course helped to implement the change project.

CYCLE 2: Potential value

Activities and interactions can produce "knowledge capital," whose value lies in its potential to be realized in the future. Such knowledge can take the form of personal assets, relationships and connections, resources, collective intangible assets, transformed ability to learn. Potential value of the change project includes:

– building new partnerships in teacher education with staff from different countries (colleagues from the network can contribute as lecturers to workshops and webinars in teacher training for education for sustainable development or as critical friends in discussions of difficulties for implementing the change project);

– implementing new study materials received from foreign colleagues, e.g. new teaching materials on education for sustainable development, cases on sustainable development, etc.;

– transforming ability to learn: increasing capacity to work together with colleagues in an education for sustainable development community; deepening experience in e-learning.

CYCLE 3: Applied value

The applied value of the change project refers to changes that take place in practice, particularly:

– developing teachers' professional competences;

– increasing the quality of the educational process (via new teaching techniques and through increase in a number of inspired teachers ready for changes);

– changing students' understanding of what matters in higher education (through students' active involvement into the study process).

CYCLE 4: Realized value

The emphasis of realized value is on improved performance, which results from the changed practice. On the one hand, teachers (so called "change-makers") teach students in a non-traditional way using active learning techniques and including elements of education for sustainable development into their existing courses. On another hand, students influence other teachers who teach in a traditional way, stimulating them to change. Both students and teachers, who are

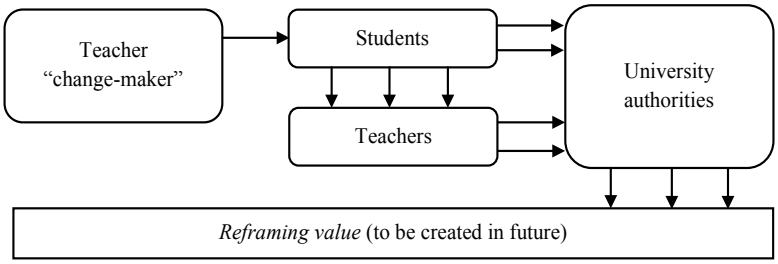

Figure 1. From realized value to reframing value

Source: own elaboration.

ready for change, influence University authorities by asking them to implement the changes in the curriculum and making them part of new practice at the university.

CYCLE 5: Reframing value

Reframing value is created when social learning causes a reconsideration of the learning imperatives and the criteria by which success is defined. In the context of the change project reframing value includes reframing strategies, goals and values towards education for sustainable development. It is expected that the strong social voice of both students and teachers will motivate the university authorities to include the sustainable development issues in the university policy. At the same time changes at both individual (teacher or student) and collective (majority of teachers or students) levels should take place to make changes happen at the organizational level.

3. Conclusion

Although Ukraine has ratified United Nation's Sustainable Development Goals, there are still almost no courses related to sustainable development issues in higher education of Ukraine.

The main idea of the paper is to promote education for sustainable development through teacher training, as teachers can include some sustainable development issues in their existing courses, giving some concrete examples and cases.

Active learning techniques are becoming more and more popular, and they can be applied in different areas of study. The change project focusing on teacher training in the use of active learning techniques for education for sustainable development is something totally new in Ukraine.

Considering the fact that every teacher in Ukraine is obliged to undergo teacher training at least once during a five-year period, the change project involves the dissemination of knowledge to every 1 out of 3 teachers from Sumy State University during the course in active learning techniques to support education for sustainable development during the next five years.

The purpose of the pilot change project was to trigger general changes in university policy towards education for sustainable development in the future. At the moment the idea is just to launch an introductory course for teachers focusing on education for sustainable development. Future studies could be dedicated to specific aspects and difficulties of integrating sustainability in the strategy of the university.

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Edukacja na rzecz zrównoważonego rozwoju poprzez kształcenie nauczycieli

Streszczenie. Artykuł przedstawia projekt zmian w uczelni wyższej. Celem projektu jest promocja edukacji na rzecz zrównoważonego rozwoju poprzez kształcenie nauczycieli z uwzględnieniem tematyki zrównoważonego rozwoju w programie kształcenie nauczycieli, w którym szczególny nacisk kładzie się na techniki aktywnego uczenia się. Autorzy opisują działania zaplanowane w projekcie zmian, w tym poszczególne etapy. Projekt składa się z pięciu cykli oraz opisuje proces tworzenia wartości (pośredniej, potencjalnej, praktycznej, zrealizowanej i przekształcającej).

Słowa kluczowe: edukacja, zrównoważony rozwój, cele zrównoważonego rozwoju, szkolenie nauczycieli, aktywne uczenie się, projekt zmian

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DOI: 10.26349/st.per.0023.02

Zbigniew H. Gontar*

Towards Challenge-driven Sustainability Education[1]

Abstract. The paper is part of the author's research on developing a final project for the "Baltic University Programme (BUP) Teachers Course on Education for Sustainable Development (ESD) in Higher Education," which took place from September 17 to February 18. The purpose of this paper is to discuss the following course-related concerns: What is challenge-driven education and why should it be considered as a strategy for education for sustainable development (ESD)? What are the practical considerations and barriers to expanding challenge-driven education? The paper refers to strategic management in education. It describes challenge-driven education as an option for universities considering various sustainability strategies. The paper focuses on the proposed idea of BUP cloud academia for sustainable development, and analyzes the results of surveys on pros and cons of the shift to cloud computing.

Keywords: sustainability education, education for sustainable development, challenge-driven education

1. Introduction

The emergence of sustainability education (SE) and its evolution towards challenge-driven education for sustainable development (ESD) is the main subject of the paper. The author discusses the concepts and challenges of ESD and how

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[1] The article presents the results of research financed from the internal grant of the Faculty of Management at the University of Lodz.

it is organized to follow both the top-down (e.g. xMOOCs[2]) and bottom-up approach (e.g. cMOOCs[3], and challenge-driven education) using the Scopus-based analysis of peered-reviewed literature, and his own experience in developing challenge-driven curricula. These considerations are concluded by the presentation of a case study of challenge-driven sustainability education curriculum that was developed as a final project for the BUP Teachers Course on Education for Sustainable Development in Higher Education, developed by the Swedish International Centre of Education for Sustainable Development (SWEDESD), Åbo Akademi University and the Baltic University Programme (BUP), and run from September 2017 to February 2018 as online and face-to-face events. The paper ends with a discussion of the pros and cons of this idea based on results of research into the shift of businesses to cloud computing.

ESD is regarded in the paper as an inclusive part of Global Education defined in the Maastricht Declaration on Global Education in Europe (2003) in the sense of "education that opens people's eyes and minds to the realities of the world, and awakens them to bring about a world of greater justice, equity and human rights for all. Global Education encompasses Development Education, Human Rights Education, Education for Sustainability, Education for Peace and Conflict Prevention and Intercultural Education; being the global dimensions of Education for Citizenship."[4]

2. The review of the history and trends of challenge-driven projects in sustainability education

There is an increasing trend at universities and other higher education institutes towards integrating sustainable development across the curriculum, as an operational, strategic and outreach principle, which in turn leads to a change in university culture [Adams, Martin & Boom 2018: 434-445]. The origins of this phenomenon can be traced back to the Stockholm Declaration on the Human Environment from 1972, and the Talloires Declaration from 1990 – a ten-point

[2] xMOOC stands for eXtended Massive Open Online Course, and is based on traditional university courses.

[3] cMOOC stands for connectivist, as defined by Stephen Downes, and means that rather than being delivered by an individual instructor, as in traditional university courses, cMOOCs involve groups of people learning together, and resemble Personal Learning Network in the sense of e.g. Collaborative Open Online Projects (COOP). Source: http://blog.extensionengine.com/xmooc-vs-cmooc [access: 1.12.2018].

[4] www.gene.eu [access: 1.12.2018].

action plan for incorporating sustainability and environmental literacy in teaching, research, operations and outreach at colleges and universities.[5] Among other initiatives of this kind, one should mention the Higher Education Sustainability Initiative (HESI), created as a partnership of United Nations entities in the run-up to the UN's Conference on Sustainable Development (Rio+20) [Adams Martin & Boom 2018: 434-445].

In 2005, the United Nations Economic Commission for Europe (UNECE) defined recommendations for higher education as the following sustainable development themes: biological and landscape diversity, environmental protection, natural resource management, rural and urban development, production and consumption patterns, economy, corporate responsibility, poverty alleviation, responsibility in local and global context, democracy and governance, justice, security, peace, health, citizenship, human rights, gender equality, cultural diversity, and ethics [Friman et al. 2018: 364-372]. These themes – and any other sustainability-related issues – can be introduced to education in two following ways: top-down – through lectures, complemented by reading materials (e.g. UNESCO programme entitled Teaching and Learning for a Sustainable Future[6]), and bottom-up – through the application of the pedagogical principle of 'learning by doing', whereby students plan and employ problem-solving techniques (e.g. life cycle assessment of a product or a technological system in co-operation with a company or other type of organization) [Cosme et al. 2018]. In both cases, sustainability education is expected to generate interdisciplinarity and transdisciplinarity through collaboration between a diverse range of students, faculty, and stakeholders [Tamura et al. 2018].

The current top-down teaching trend is the use of xMOOC. MOOCs have been offered since 2008 and have become popular since 2012, and from the beginning require huge efforts ("Coursera – educational business oriented MOOC – started with a venture capital of US$ 16 million in 2012 and raised US$ 85 million in three years," and "edX – university education oriented MOOC – started with US$ 30 million investment each from Harvard University and MIT/Massachusetts Institute of Technology"[7]).

The bottom-up approach involves learning how to incorporate transdisciplinarity into different types of subjects, study problem-solving, and work with local stakeholders [Tamura et al. 2018].

The challenge is to establish a global/regional network (e.g. BUP network) of academia-business cloud academia for sustainable development, where students can solve sustainability challenges as part of academic courses, gain experience

[5] http://ulsf.org/talloires-declaration/ [access: 1.12.2018].

[6] www.unesco.org/education/tlsf/ [access: 1.12.2018].

[7] The comprehensive cost-revenue analysis of MOOCs is available in Tirthali, 2016.

through problem solving, and possibly create start-ups or get hired on the basis of business-academia collaboration.[8] This would be in accordance with the Responsible Research and Innovation (RRI) strategy, which has been paving its way to universities for several years. The concept of RRI is rooted in the following five core well-established scientific operations: assessment of technology (examination of commercialization potential of a technology), engineering ethics (ethics of new technology), community engagement in research, foresight initiatives and socio-economic implications of new technologies (Ethical, Legal and Social Aspects of Technologies, ELSEA; Ethical, Legal, and Social Implications, ELSI and others) [Forsberg et al. 2015]. The key reasons for the emergence of RRI was the weak participation of scientific institutions in economic development, the need to address the major issues of the contemporary world, an attempt to find ways of eliminating economic and technological limitations constraining the contemporary economy, and the desire to improve the standard of living. Examples of effective engagement of the scientific community in solving the above-mentioned problems show that there are untapped opportunities in this area (i.e. model of demo and research platform designed to test and present new solutions in the field of robotics and artificial intelligence, developed by the German Research Centre for Artificial Intelligence,[9] or a model factory established by the Aachen University, working on the design and construction of electric cars and implementation of related services,[10] and an environment for individual manufacturing (FabLab), equipped with 3D printers and other devices and software necessary in a micro-factory developed at the Massachusetts Institute of Technology).

2.1. Top-down university designed curriculum

There are several approaches that make it possible to include sustainable education at university level [Kishita et al. 2018]: establishing stand-alone sustainable universities, developing sustainable education programs within existing departments, and embedding sustainability-related courses within existing departments.

Discussed below are advantages and barriers to introducing top-down university designed curriculum in the sense of the BUP Teachers Course on Education for Sustainable Development in Higher Education. The course encompasses the following cycles[11]: e-learning – introductory course on Sustainability, ESD

[8] The presented concept is based on the case study of Telanto Academic Business Cloud Academia: https://telanto.com/ [access: 1.12.2018].

[9] A model factory was established in Kaiserslautern in 2007: Smart FactoryKL.

[10] Dynamic extensive network of partners and suppliers coordinated through process management methods.

[11] http://swedesd.uu.se/academy/bup-course/ [access: 1.12.2018].

(Moodle) including planning the change project (1 month, September – October 2017), workshop on SD issues and ESD methodology including the development of the change project (2017, October, 22-26 in Kaunas, Lithuania, in connection with the BUP teachers conference), the development of the change project at the home university (e.g. with a local team of colleagues and students) including the preparation of report/poster/slideshow with a plan to implementing a course or programme on a sustainability related theme, including teaching and learning methods, in participants' universities (November – February), a workshop including critical reflection – taking the Change Project forward and reporting and peer learning with course participants (3 days workshop February 2018, location open), and finally after the course – implementation of the change project at the home university including an opportunity to publish the project reports at BUP website and/or in a scientific journal.

The aim of the course was to "support university teachers in their efforts to integrate sustainable development priorities in their teaching and courses and programmes, to strengthen the implementation of the United Nations Sustainable Development goals; e.g. Goal 4, which seeks to ensure inclusive and equitable quality education and promote life-long learning opportunities for all, Goal 13 aimed at taking urgent action to combat climate change and its impacts, and Goal 12 that concentrate on ensuring sustainable consumption and production patterns."[12]

The pros: professional connections between researchers/educators, and expanding subject-specific knowledge. The cons: time, the theory-practice gap, and overcrowded curriculum.

It seems that the most benefits for the BUP program would be achieved by introducing elements of challenge driven education. This would make it possible to overcome the theory-practice gap and involve the BUP network in solving real sustainability problems in the Baltic Sea region.

2.2. Bottom-up university designed curriculum

This chapter presents the curriculum of a new course that would concentrate on sustainability decision making in linking project management to sustainability strategy and innovation management in smart and sustainable cities.

The idea of a smart and sustainable city is part of the „third wave" – old but still present concept created by Alvin Toffler [1997], who proposed a new model of economy based on human capital (now we would say: smart society), knowledge (now: smart analytics), biosphere sensitivity (now: sustainable development goals) and IT data processing (now: Internet of Everything, Big Data, Cyber-

[12] Ibidem.

Physical Systems, etc.). In *Creating A New Civilization: The Politics Of The Third Wave*, Toffler proposed a complete change of the classic concept of farming and industrial production, a new lifestyle, changes in the way of work, referring to life, a new shape of economic life, etc. [Toffler 1996]. Smart cities can be regarded as living laboratories of this new ideas. ICT corporations transforming smart cities are supposed not only to earn but also to change the world as part of a social market economy. An example of these connections is the involvement of IMB,[13] and the Bill & Melinda Gates Foundation[14] in promoting sustainable development.

The proposed course provides the background of the Smart City idea in the sense of Toffler's Third Wave concept and emphasizes the problem of innovation project management in the sense of projects assessment and hierarchization from a sustainable point of view. The proposed projects are supposed to be a remedy for challenge goals that will be provided by cities that seek an improvement in their business strategy. It is planned that the university uses its existing contacts with the public, and business managers, who report problems to the university that they cannot deal with as a list of challenge goals from Smart Cities.

Students – taking up the challenge of solving these problems – will be divided into groups of approximately five students and try to apply new concepts and propose new scenarios, on the basis of which it would be possible to assess and establish a hierarchy of proposals. Finally, each group of students will look for solutions to problems reported during classes devoted to solving problems and making decisions.

The study environment and equipment planned for use would encompass the following elements: IT laboratory, equipped with e.g. Open Office, programming and analytical tools. The use of specific tools will depend on students' IT literacy. The following methods will be used so as to implement the content of the course: design thinking to cope with the challenge goals, various methods to assess the proposed projects (including Analytic Hierarchy Process/AHP and Data Envelopment Analysis/DEA), and various analytical methods derived from data mining for giving recommendations (including association categorization, and association rules mining).

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[13] E.g. in Europe, IBM is a partner in a coalition of business and European leaders (Pact for Youth) to address high youth unemployment and to help prepare young people for quality jobs and 100,000 apprenticeships in Science, Technology, Engineering and Mathematics (STEM) industries. Source: www.ibm.com [access: 1.12.2018].

[14] E.g. in 2018, the Gates Foundation will contribute USD 50 million in financing, as well as an additional USD 12.5 million in technical assistance, to investment projects in the health sector in Africa through the EU's framework to improve sustainable investments in Africa. The European Commission will match this contribution with another €50 million. Source: www.gatesfoundation.org [access: 1.12.2018].

Assessment of student projects will be done on the basis of the quality of proposed projects, and the results of projects assessment.

The proposal is thematically oriented (smart cities), focusing on some specific aspects of sustainability, however it is the core of the Third Wave idea, and it is important to get knowledge about the most important aspects of the sustainability concept.

The target audience for the proposed course includes students of first-cycle studies (B.A. undergraduate). Expected outcomes of the course are teaching materials.

The project addresses the Sustainable Development Goals (SDGs), which are closely related to the idea of Toffler's "third wave", i.e. human capital (smart society), knowledge (smart analytics), "biosphere sensitivity" (sustainable development goals) and IT data processing (Internet of Everything, big data, cybernetic-physical systems), and there are.

SDG 3 "Good health and well-being,"[15]

SDG 7 "Affordable and clean energy,"[16]

SDG 8 "Decent work and economic growth,"[17]

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[15] "Ensuring healthy lives and promoting the well-being for all at all ages is essential to sustainable development." Source: www.un.org/sustainabledevelopment/health/To cope with that problem smart cities introduces Well Living Labs [access: 1.12.2018].

[16] "Sustainable Energy for All initiative to ensure universal access to modern energy services, improve efficiency and increase use of renewable sources." Source: www.un.org/sustainabledevelopment/energy/ [access: 1.12.2018]. Smart cities introduce this idea through smart grid initiatives, introduced in 2005 for the designation of a power system built around the idea of transforming passive energy consumers into active network nodes, undertaking activities in the field of, consumption management energy (reducing consumption, influencing the profile of energy consumption) by controlling devices with a significant power consumption, such as devices heating, air conditioners, washing machines, etc.), delivery to the power system surplus energy from renewable sources (photovoltaic, farms wind, small hydropower, cogeneration) or storage energy; thus, any energy recipient, after installing the necessary infrastructure and software, it becomes simultaneously a producer of energy, similar to currently operating power plants

[17] "Having a job doesn't guarantee the ability to escape from poverty. Sustainable economic growth will require societies to create the conditions that allow people to have quality jobs that stimulate the economy while not harming the environment." Source: www.un.org/sustainabledevelopment/economic-growth/ [access: 1.12.2018]. Smart cities cope with that problem using FabLab concept, introduced at MIT as a result of implementation of a project funded by the National Science Foundation, aimed at introducing new technologies in a community affected by the crisis. The first implementations of this idea took place in African-American community in Boston, rural communities in Ghana, in Norway near the Arctic Circle and in ashram in India, and, later, in the urban communities of Amsterdam and Barcelona, etc. each FabLab should be equipped with devices, whose total cost amounts to around 80,000 USD; in accordance with the original idea, these devices make it possible to manufacture almost everything; FabLabs are obliged to make their projects and educational programs accessible, creating an open community, well-known in the IT community.

SDG 9 "Industry, innovation and infrastructure,"[18]
SDG 11 "Sustainable cities and communitieS,"[19]
SDG 12 "Responsible consumption and production,"[20]
SDG 13 "Climate action"[21].

What value does the project of new course bring/add to the universities? Possible new course added to the curriculum of SGH, Warsaw School of Economics, engagement of the University in solving challenge problems in Smart Cities (a way of incorporating Responsible Research & Innovation strategy), understanding the background of the sustainability concept in the sense of the Third Wave idea, and establishing close relations between the university and municipalities of Smart Cities.

3. Barriers to establishing a cloud-hosted sustainable academia

The suggestion of a new ESD course described in the previous chapter is a preliminary step to a more advanced plan for establishing a BUP challenge-driven

[18] "Growth in productivity and incomes, and improvements in health and education outcomes require investment in infrastructure. Without technology and innovation, industrialization will not happen, and without industrialization, development will not happen." Source: www.un.org/sustainabledevelopment/infrastructure-industrialization/ [access: 1.12.2018]. In smart cities, the most important idea referring to these issues is smart factory, considered in this paper in two ways, first, as a factory with a specific location, equipped with machines and devices which utilize ideas taken from two concepts, namely the Internet of Things and the physical and cybernetic systems and second, as a dynamic fabless production structure, which involves a number of production units located in the region.

[19] "Cities are hubs for ideas, commerce, culture, science, productivity, social development and much more. Common urban challenges include congestion, lack of funds to provide basic services, a shortage of adequate housing and declining infrastructure." Source: www.un.org/sustainabledevelopment/cities/ [access: 1.12.2018]. The most comprehensive idea of such sustainable and smart city is a concept of perfect city, introduced for example in Berlin and Tokyo by the Panasonic corporation.

[20] "Sustainable consumption and production is about promoting resource and energy efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all. It involves engaging consumers through awareness-raising and education on sustainable consumption and lifestyles, providing consumers with adequate information through standards and labels and engaging in sustainable public procurement, among others." Source: www.un.org/sustainabledevelopment/sustainable-consumption-production/ [access: 1.12.2018]. In smart cities, this idea is promoted mainly through sustainable business model innovations.

[21] "Climate change is disrupting national economies and affecting lives, costing people, communities and countries dearly today and even more tomorrow. To address climate change, countries adopted the Paris Agreement at the COP21 in Paris on 12 December 2015. The Agreement entered into force shortly thereafter, on 4 November 2016. In the agreement, all countries agreed to work to limit global temperature rise to well below 2 degrees Celsius, and given the grave risks, to strive for 1.5 degrees Celsius." Source: www.un.org/sustainabledevelopment/climate-change-2/ [access: 1.12.2018].

cloud sustainability university. Cloud computing offers the opportunity to establish a BUP cloud academia for sustainable development along similar lines as, for example, an Academic Business Cloud for Challenger of TELANTO Inc.[22] TELANTO formed a network of academic and industry partners (including SAP, and Adidas), which allows participants to take up challenges during courses offered in the Product-Service System (PSS) business model. TELANTO offers a mix of educational products as courses, and services as solving the problems for the business [Bacchetti et al. 2016].

In the area of sustainability, there are many university and business networks focusing on ESD (Table 1). Their conversion to challenge-driven networks or the establishment of a new network of this type is the main idea of this chapter. The author has extensive experience in working with challenge driven education, primarily gained during his work as a director of education at the Innovation Center of the University of Lodz, where students evaluated innovative ideas and prepared business plans for their commercialization and while conducting master's seminars, where students had an opportunity to deal with problems reported by public utility companies. The experience gained during these activities enables the author to conclude that similar actions can be implemented in relation to ESD. The fact that there are no similar initiatives so far is probably due to a number of barriers that outweigh the expected benefits of this type of approach to ESD. These issues will be discussed in detail in subsequent paragraphs on the basis of a survey of manufacturing enterprises regarding the shift to cloud computing. The results of this survey will be mapped onto the situation in ESD teaching. This will help to identify problems and formulate guidelines for overcoming difficulties in the transformation of networks such as BUP to Academic Business Cloud for Challenger. The choice of the manufacturing domain was dictated by the assumption that it is possible to repeat successes of German academia projects in manufacturing, i.e. SmartFactory^{KL} or StreetScooter.

Migration to the cloud with education for sustainable development creates specific challenges [Attaran et al. 2017], however – despite issues specific to education – due to a strength of the Industry 4.0 strategy, of which cloud computing is a part, the pros & cons related to the introduction of new IT solutions are similar regardless of the domain. Tables 2 and 3 contain the pros and cons identified by the author and a group of researchers from the University of Lodz, and tested on a group of 400 manufacturing companies. It can be seen that regardless of the domain, the implementation of cloud solutions creates similar opportunities and challenges.

[22] https://telanto.com/ [access: 1.12.2018].

Table 1. Sustainable education networks

Network	The aim and achievements	History
The Baltic University Programme (BUP)	The BUP focuses on questions of sustainable development, environmental protection, and democracy in the Baltic Sea region through developing university courses, support interdisciplinary research cooperation, and by participation in transdisciplinary projects in cooperation with authorities, municipalities and others.	Established in 1991, creates and coordinates undergraduate and master level courses at its participating institutions and sponsors joint research projects focusing on sustainable development in the region.
Baltic & Black Sea Circle Consortium BBCC Baltic & Black Sea Circle Consortium	A platform for an experience exchange among researchers and experts in ESD, responsible for the annual international scientific conference "Sustainable Development. Culture. Education," allowing participants to exchange ideas concerning sustainability through conferences, Journal of Teacher Education for Sustainability and the Web Page of the Institute of Sustainable Education & BBCC (www.ise-lv.eu).	Created in 2005, on the basis of the cooperation network of the Journal of Teacher Education and Training (JTET) which was established in 2002 (since 2007 – Journal of Teacher Education for Sustainability or JTEFS).
Baltic Sea Region (BSR) Network on Education for Sustainable Development (BSRESDN)	A cross-border, cross-sectoral network on ESD within the BSR, encouraging interaction, joint learning and joint actions among ESD practitioners in educational systems through organised conferences, capacity building training and workshops.	Created in 2012, and having developing Local Hubs for Sustainable Development in BSR.
NUASNSCN Nordic Sustainable Campus Network	The network is targeted to sustainability/environmental staff working in the Nordic higher education institutions – both in administration and teaching.	Created in 2012, during 2014 NSCN became a part of NUAS (the Nordic Association of University Administration) as a new working group called NUAS Sustainability.
UE4SD University Educators for Sustainable Development	UE4SD most interesting achievement is an online toolkit containing teaching materials focused on Education for Sustainable Development (ESD) http://platform.ue4sd.eu/.	European project 2013-2016, founded by the European Commission under the Lifelong Learning Programme - Erasmus Academic Networks.

Source: own elaboration.

Table 2. Migration to the cloud – list of advantages used in the study

Advantages [Bartkiewicz & Gontar 2018]	Advantages [Almajalid 2017]
1. Lower operational costs 2. Better adaptation to customers' and business partners' expectations 3. Better data utilization for knowledge management 4. New product development and creation of innovative solutions 5. Development of new business models 6. Better communication with business environment 7. Increased work efficiency 8. Reducing product time-to-market 9. Greater flexibility in offered products and services 10. Allows you to use computer software so far unavailable due to the high cost 11. More efficient allocation of resources 12. Improved manufacturing preparation 13. Improved manufacturing processes 14. Improved quality management processes 15. Fast access to knowledge 16. Access to specific production-relevant data 17. Faster and more efficient data processing 18. Easy access to data and applications from anywhere 19. Replacement several applications with one environment 20. Guaranteed security (of the data and systems) 21. Ensuring better continuity of IT systems functioning 22. Fast access to newly introduced ICT technologies 23. More efficient application update 24. Reduced problems with infrastructure maintenance 25. Increased ability to match computer systems functionality to business processes	1. Enabling use the technological infrastructure of academia by other firms 2. Achieving savings in energy and other resources. 3. Introduction new ways of teaching. 4. Exempting from data management. 5. Strengthening the possibilities of collaboration and secure communication. 6. Opportunity to access, publish and share class calendars, documents, and web pages 7. Problems including insufficient infrastructure, lack of teachers, low rates of graduation, as well as tiny classrooms can be addressed by use of cloud computing. 8. Geographical distances will be bridged as people can study from anywhere 9. Institutions that lack adequate infrastructure can also provide education of high quality. 10. Democratization of education is possible since cloud computing can be rapidly deployed by the institution. 11. Upgrades and maintenance ought to be easier. 12. IT capital expenditure is eliminated, hence a reduction in the overall cost outlay. 13. Service is available anytime any day as required by the user. 14. Good accessibility because service and data are available to the public. 15. Enabling reduction of the carbon footprint. 16. It is user friendly and can be used to manage large data quantity.

Source: own elaboration.

Establishing BUP cloud-hosted sustainable academia – as it is proposed in the paper – means integration of education not only with sustainability issues, but with smart manufacturing as well.

Table 3. Migration to the cloud – list of barriers used in the study

Barriers [Bartkiewicz & Gontar 2018]	Challenges [Attaran 2017]
1. Issues related to the protection of personal data 2. Legal aspects 3. Limited trust in new technologies 4. Concerns about the data and services' security 5. Fear of the cloud service providers' activities 6. Implementation costs 7. Difficulties with the integration of solutions 8. Concerns about the quality of services provided by cloud providers 9. Difficult access due to slow connection 10. Lack of knowledge and competence 11. Unknown influence on the company's management 12. Complexity of SLA agreements	1. Business discontinuity 2. Performance inconsistence due to sharing of resources with various other companies 3. Not all applications run on Cloud 4. Transparency: not getting a whole lot of insight into your network 5. Dissemination policies 6. Fewer options 7. Standard adherence 8. Lock-in 9. Lack of confidence 10. Organizational support 11. Network vulnerability 12. Platform inconsistency 13. Availability of features 14. Lack of control and options for scalability 15. Reliability and security 16. Security gaps & human errors 17. Standard adherence 18. Intellectual property

Source: own elaboration.

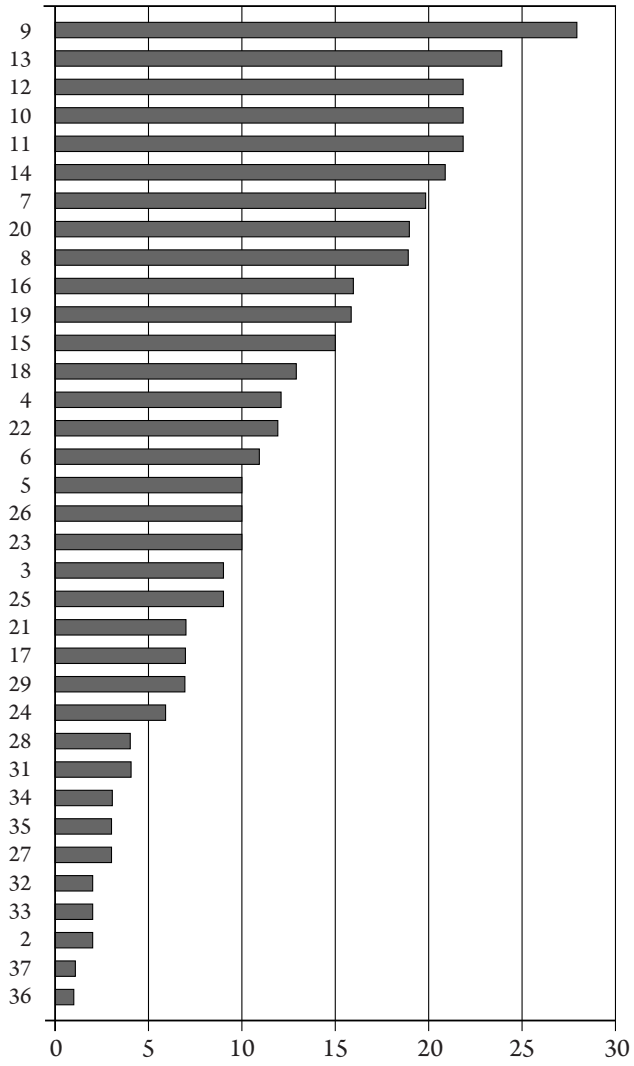
Most previous attempts to establish a top-down sustainable university rely on the xMOOC concept. Examples of such initiatives are given in Table 4. In addition to the previously mentioned Coursera, and edX, the courses from the openSAP MOOC platform have been added because openSAP is treated as a representative example showing the way of supporting the idea of sustainable development using digital transformation by MOOC education.

Table 4. Sustainable education (xMOOC)

Course	By	MOOCs
Sustainability and Business Innovation	Peter Graf	openSAP
Sustainability Through Digital Transformation	Daniel Schmid, Will Ritzrau and Barbara Fluegge	openSAP
How is Digitization Connected with Sustainability?	Susanne Mueller	openSAP
Strategy and Sustainability	Mike Rosenberg	Coursera
Co-Creating Sustainable Cities	Gert Spaargaren, Ellen van Bueren	edX

Source: own elaboration.

Chart 1. Number of respondents who reported a specific number of pros and cons of cloud computing



Source: own elaboration.

Because the concept of establishing BUP cloud-hosted sustainable academia presented in the paper is integrated with smart manufacturing, instead of investigating issues related to education for sustainable development, the results of a survey involving about 400 manufacturing enterprises that use cloud-based IT solutions in various areas were analyzed so as to apply the survey results to the

situation in the area of education. The survey contained questions about barriers and benefits encountered in the process of shifting IT business solutions to the cloud.[23] In this section the relationships between the obtained categories have been analyzed using association rules mining. The results help to identify the conceptual structure of the problem and build a model of associative relationships between the barriers and benefits connected with shifting IT solutions to the computational cloud.

Chart 1 shows the number of respondents (horizontal axis) who reported specific numbers of barriers and benefits of the transition to the cloud (values on the vertical axis to the left of each bar). The analysis carried out in the article is based on the results of associative grouping, which seeks to capture underlying aspects of factors associated with moving a business to cloud computing.

Figures 1 and 2 show that in absolute numbers the most frequently indicated challenges were: "Concerns about data and services' security," and "Issues related to the protection of personal data," and the most frequently indicated benefit is "Easy access to data and applications from anywhere."

To generate consistent clusters of positive and negative factors, the algorithm for finding complete graphs was applied. The grouping of factors obtained as a result of the analysis, defining the benefits of the shift to the cloud, are as follows: pros {21, 24}, {22, 23}, {1, 17}, {7, 11}, cons: {5, 8}, {1, 4}.

The groups {21, 24}, {22, 23} are related to IT management in the enterprise, including ensuring better continuity of IT systems operations, fast access to newly released ICT technologies, more efficient application updates, reduced problems with infrastructure maintenance, creating a group of benefits related to this field, and indicating that the respondents connect issues related to manufacturing infrastructure. This indicates a desire to look for IT solutions that support innovation in manufacturing.

The groups {1, 17} and {7, 11} indicate that respondents also associate issues related to operational efficiency and effectiveness in manufacturing operations in the sense of lower operational costs (associated with manufacturing), increased work efficiency, more efficient allocation of resources, and faster and more efficient data processing.

The group{1, 4} addresses the concerns of respondents regarding legal issues, especially the protection of personal data, and the data and services' security. They can be described as a formal and legal area.

Another group of barriers {5, 8} is associated with fears about the functioning of cloud service providers, in particular, the sufficient quality of services. This

[23] Detailed considerations on the nature and characteristics of specific similarities between the benefits and barriers of transformation to cloud computing: Bartkiewicz & Gontar 2018.

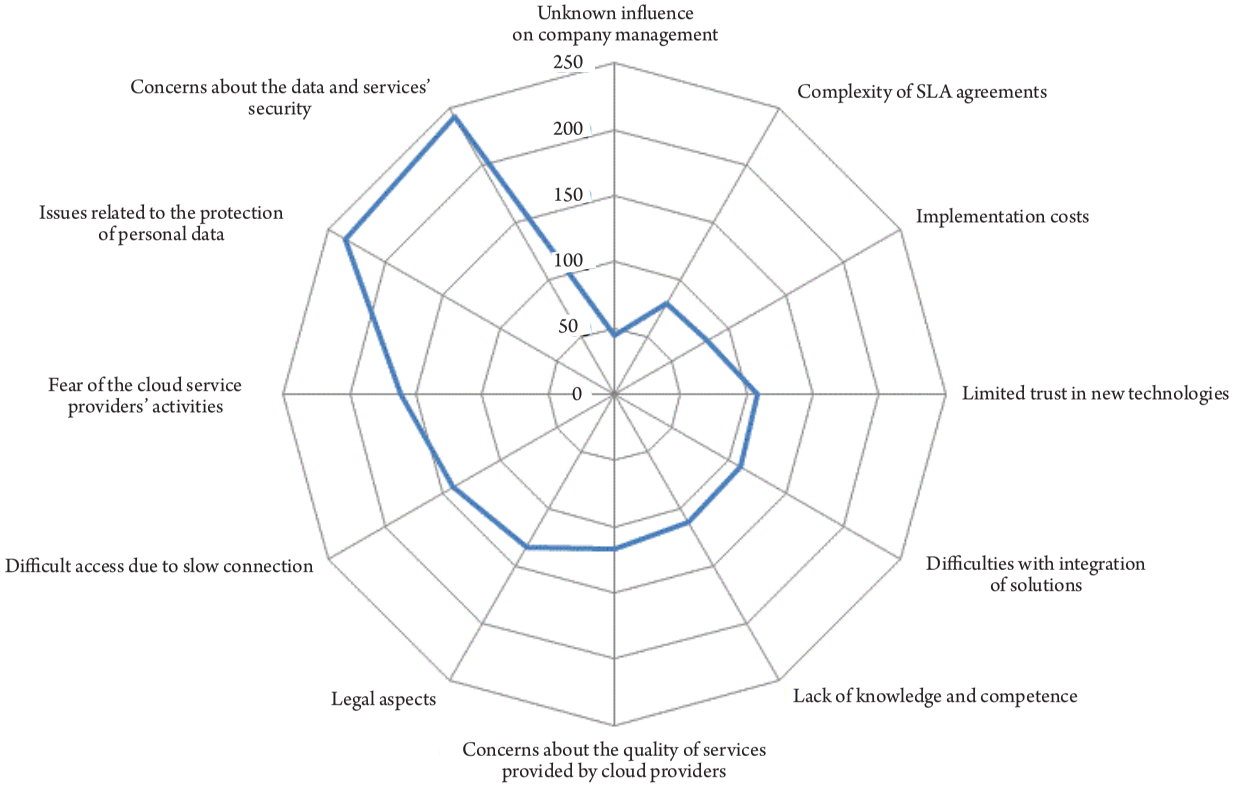


Figure 1. Respondents' choices concerning the disadvantages of cloud computing

Source: own elaboration.

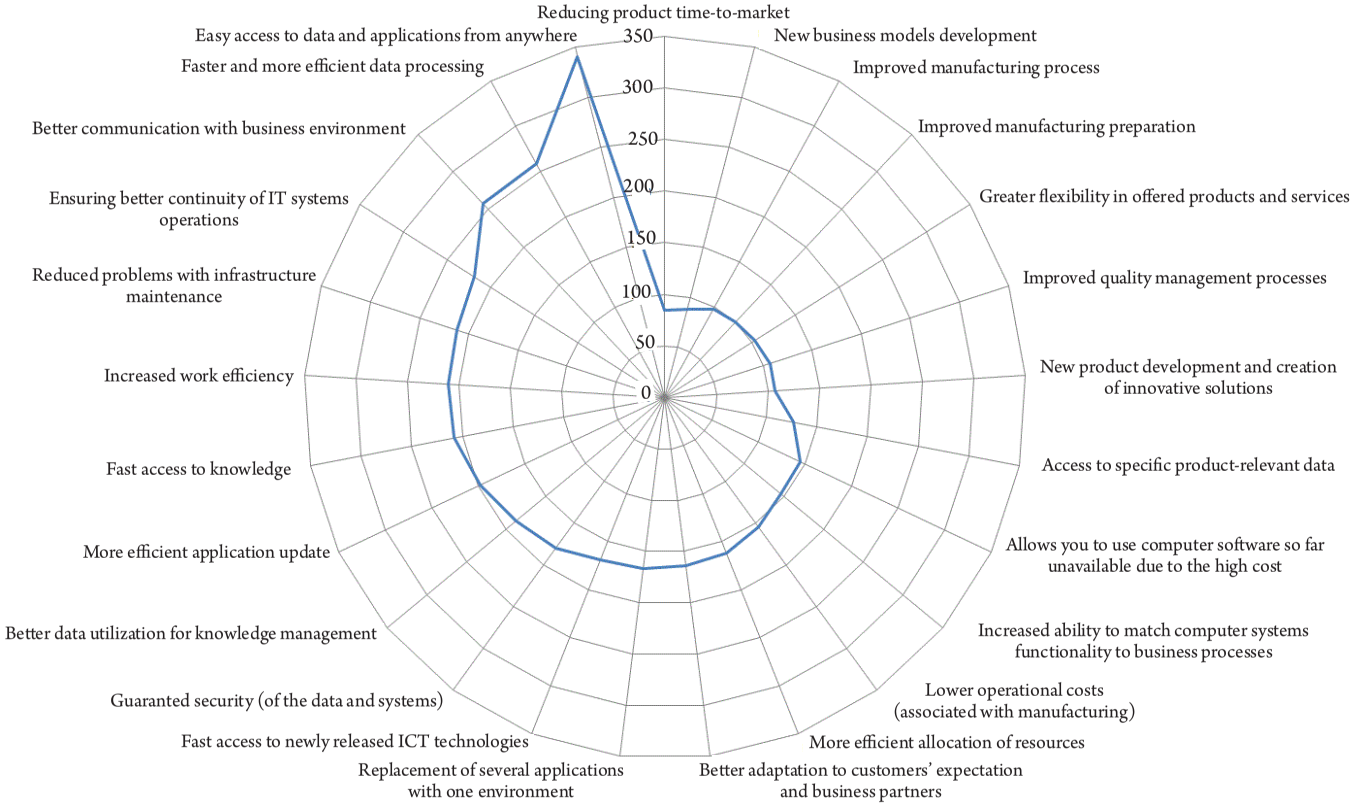


Figure 2. Respondents' choices concerning the advantages of cloud computing

Source: own elaboration.

indicates the respondents' concerns about the negative impact of external factors on the manufacturing processes.

So, a number of groups related to pros and cons have been identified, which could be treated as the basis for further investigations by cloud computing governance managers, education policy makers, and university risk managers in education institutions.

4. Conclusion

The paper addressed the problem of cloud-based, and challenge-driven sustainability education. After defining the problem, the results of a survey on the migration to cloud computing were presented. The survey was conducted among manufacturing companies, and the results were applied to an educational business by way of analogy. The global trends in business, i.e. the focus on the sustainable development goals and Industry 4.0 (e.g. cloud computing), characterize every modern business, and they interpenetrate each other. Challenge-driven education is a modern business, in which academia, the business sector and authorities are involved in joint problem solving. It focuses on setting new business paths and offers support for developing living laboratories in manufacturing, as shown in the examples from Germany, mentioned in the article. It should be considered as a strategy for education for sustainable development (ESD) considering RRI concept. The practical considerations and barriers to expanding challenge-driven education were analyzed using the example of the shift to cloud computing, assuming that the most important concept in this area is a cloud sustainable educational network. It should be noted that this analysis was focused on manufacturing enterprises and the findings cannot be immediately generalized to an educational business. However, the dependences identified in the adoption of cloud solutions can provide certain general characteristics, given the universal global trends in business.

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W stronę edukacji na rzecz zrównoważonego rozwoju zdolnej podjąć wyzwania współczesnego świata

Streszczenie. Artykuł jest częścią projektu autorskiego realizowanego od 17 września 2017 do 18 lutego 2018 r. w ramach programu „Baltic University Program (BUP) Teachers Course on Education for Sustainable Development (ESD) in Higher Education". Celem artykułu jest omówienie następujących zagadnień związanych z edukacją na rzecz zrównoważonego rozwoju: czym jest nauczanie stymulowane wyzwaniami współczesnego świata i dlaczego powinno być uwzględnione w strategii rozwoju edukacji na rzecz zrównoważonego rozwoju? Jakie są praktyczne korzyści i bariery rozwoju nauczania opartego na wyzwaniach współczesnego świata? Artykuł dotyczy zarządzania strategicznego w edukacji. Opisuje edukację opartą na wyzwaniach jako opcję dla uniwersytetów rozważających różne strategie zrównoważonego rozwoju. Zaproponowano w nim ideę wirtualnego uniwersytetu „BUP cloud academia for sustainable development" oraz przeanalizowano rezultaty badań dotyczących zalet i wad wykorzystania rozwiązań chmurowych (*cloud computing*).

Słowa kluczowe: zrównoważona edukacja, edukacja na rzecz zrównoważonego rozwoju, nauczanie stymulowane wyzwaniami współczesnego świata

Studia Periegetica nr 3(23)/2018
DOI: 10.26349/st.per.0023.03

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Active Learning as a Means to Promote Education for Sustainable Development in the Classroom: A Case Study of Implementation in the Course "Multilevel Governance"

Abstract. The world is increasing in complexity and challenged by serious problems such as climate change, which have no easy solutions and involve stakeholders with competing values. Higher education has an integral role to play in navigating society through these daunting challenges. Educating the next generation of scholars and change agents through the framework of sustainable development clears a path for balancing environmental, societal and economic realities. Education for sustainable development must equip students with critical and "out of the box" thinking skills to develop innovative solutions to these problems. Whilst it is recognized that there is a need to develop pedagogical approaches for sustainability in education, there is a gap in the literature on pedagogical practices that promote education for sustainable development in the classroom. This study aims to bridge this gap by examining active learning as a means of promoting education for sustainable development. More specifically, it examines the use of active learning techniques in the course "Multilevel Governance" as a means of promoting education for sustainable development in the classroom. This article recommends that active learning techniques, such as group discussions, group assignments, Technology, Entertainment and Design (TED) talks, are critical to engaging students in the classroom on sustainability issues.

Keywords: active learning, Baltic Sea Region, governance, education for sustainable development, flipped classroom

1. Introduction

The world is increasing in complexity and challenged by serious problems, such as climate change, which have no easy solutions and involve stakeholders with competing values. Climate change compounds other daunting challenges includ-

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ing increasing conflict and war, poverty, lack of good governance, signs of failures of democracies including corruption, political instability, lack of access to vital services, such as education, water and sanitation, increasing populism and political instability, lack of economic opportunity and increasing population growth. Education, and in particular higher education, has a critical role to play in turning these challenges into opportunities for a sustainable future. Educating the next generation of scholars and change agents through the framework of sustainable development clears a path for balancing environmental, societal and economic realities. Education for sustainable development (ESD) must equip students with critical and "out of the box" thinking skills to develop innovative solutions to these perturbations.

United Nations Decade of Education for Sustainable Development (2005-2014) [UNESCO 2014] recommends including sustainable development issues, such as climate change and biodiversity in teaching and learning. There are many studies that examine education for sustainable development from varying perspectives. For example, one study presented online activities that can increase undergraduates' understanding of sustainability in business [Albibsson, Perera & Sautter 2011], whilst another recommended theoretical frameworks for incorporating sustainability in education [Ruisinko 2010]. While it is recognized that there is a need to develop pedagogical approaches for sustainability in education, there is a gap in the literature on teaching practices that promote education for sustainable development (ESD) in the classroom. This study aims to bridge this gap by examining active learning as a means to promoting education for sustainable development. More specifically, it examines the use of active learning techniques in the course 'Multilevel Governance' at Åbo Akademi University in Finland as a means of promoting education for sustainable development in the classroom.

2. Education for sustainable development

There are many definitions of sustainable development and sustainability, but one that is universally recognized is derived from the Brundtland report. The World Commission on Environment and Development Report entitled "Our Common Future" (more commonly known as the Brundtland Report 1987) defines sustainable development, as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [Bruntland et al. 1987: 8]. It is a process that reconciles ecological, social and economic imperatives; the ecological imperative to live within the earth's carrying capacity whilst maintaining biodiversity, the social imperative for

propagating values in a democratically governed society and economic imperative for meeting basic needs globally [Robinson & Tinker, 1997]. The definition of sustainable development was not specific, allowing stakeholders in each sector to work towards common ground.

Education for sustainable development is defined by UNESCO [2014a] as education that "allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future." Inherent in this definition is the idea that humans and the environment are interconnected, which is why this coupling must be considered in education in order to solve challenges for a sustainable future. Methods of engaging students need to change so as to help students switch from rote learning to critical thinking. This can be done by integrating sustainable development themes such as the sustainable development goals into the curriculum, as they are interconnected. ESD learning refers to: 'learning to ask critical questions; learning to clarify one's own values; learning to envision more positive and sustainable futures; learning to think systemically; learning to respond through applied learning; and "learning to explore the dialectic between tradition and innovation" [UNESCO 2011a: 8].

As such, ESD cannot be limited to courses on sustainability but must be interdisciplinary and incorporated into every subject. Using ESD as a guiding framework to teach multilevel governance is important, as governance refers to the steering of society by not just the government, but non-governmental actors including the private sector and civil society. Examining sustainability within the context of multilevel governance is important as sustainable development is governed in a multilevel environment. The goals are agreed upon by national governments at the international level, but are implemented at the local level by municipalities in each country. Understanding this can empower students to be agents of change in their role in society and through interaction with friends and family members.

In traditional higher education, students enter the classroom where lecturers fill them with information that represents the body of knowledge in a given subject. However, change through ESD at the student level requires more in-depth learning that engages critical thinking skills, self-reflection, dialogue and consciousness [van der Merwe & Albertyn 2009], moving away from the didactic approach. ESD requires "participatory teaching and learning methods like critical thinking, imagining future scenarios and making decisions in a collaborative way in order to empower learners to take action for sustainable development" [UNESCO 2014b: 20]. However, research is not aligned with this vision, as less emphasis is placed on methods used for integration of ESD and more on studying the impact of environmental issues [Wu & Shen 2016]. In the best case scenario, the closest universities come to ESD is incorporating "bolt-on" courses in the curriculum [Christensen et al. 2007], e.g. introduction to sustainability. There is consensus in the literature that there is a need for studies on new and innovative

pedagogical methods for ESD [Jabbour 2010; Springett 2005; Stubbs & Cocklin 2008]. As such, it is necessary to rethink the traditional mode of teaching to include innovative methods to hone critical thinking skills in students. This paper proposes active learning techniques as one means of renovating the traditional learning environment through teaching innovations.

3. Active learning

Active learning refers to a shift from didactic teaching towards a classroom culture with more responsible learners. It requires the lecturer to place emphasis on the student's participation over the lecturer's expert knowledge of the subject. The effectiveness of this technique of engaging students is supported by research indicating that student's attention span declines steadily after the first ten minutes of class [MacManaway 1970] and that it helps students learn by improving active construction of meaning of the material taught, by learning with others and by engagement with the material [Michael 2006]. Students can be independent readers of the course material, but they need lecturers and tutors to act as coaches to challenge their thinking and application of the material [Bergmann & Sams 2012]. Active learning stimulates students to explore attitudes and values by increasing motivation to acquire knowledge and skills. There are several techniques used by universities to apply active learning, for example, problem based learning [Wood 2008], experiential learning [Kolb 2014], action learning [Revans 1984], flipped classroom [Abeysekera & Dawson 2015] and inquiry based learning [Healey 2005]. These are implemented in the classroom through active learning activities, such as teamwork, debates, prior reading of material and discussion in class, self-reflection and case studies, worked examples, field research, peer teaching, project work and the use of games [Prince 2004]. This paper presents a course redesign to incorporate active elements into the course to better meet the goals of ESD.

4. The case study: multilevel governance at Åbo Akademi University

This case study takes place in Finland where higher education is divided into two categories: universities and universities of applied sciences. Traditionally, the latter are more geared towards education for the workforce while the former focus on the pursuit of scientific and academic knowledge and research. There are 26 universities of applied sciences and are 14 university level institutions [Fulbright

Center 2018]. This study takes place at Åbo Akademi University, the only exclusively Swedish language university in Finland, located in the former capital of Turku. The University was founded on the principle of scientific research, as captured in this quote attributed to Baron. R.A. Wrede, Åbo Akademi University Chancellor in his inauguration address in October, 1919 [Åbo Akademi University 2018]: "A prerequisite for the success of scientific research is that it remains unfettered, that it is driven only by a devotion to the truth. Liberated, in-depth research that is also aware of its limitations and, based upon it, an education borne out of an ideal ethos – such is what we expect of academia."

Currently, there are 5500 undergraduate students and 780 postgraduate students in two campuses at Turku and Vaasa, with an annual budget of 98 million euros and 1100 staff (650 work in teaching and research) [Åbo Akademi University Website 2018]. The university conforms to the European standards, with a Bachelor's degree lasting 3 years, and a Master's degree another two years. Students need 180 Finnish credits to complete the Bachelor's degree and an additional 120 credits to complete the Master's degree. Students have a degree of freedom to determine what courses they study and the rate of studying and can retake examinations up to two times if they are not happy with their grades. Students can attend lectures and pass examinations based on these lectures or can choose to take an exam based on reading materials that are considered the equivalent of lectures.

The course "multilevel governance" was taught in the Department of public administration based on the examination of reading materials. Students study the assigned texts and then submit an essay to be graded by the course instructor. This mode of delivery does not allow students to share views with other students or critically challenge their assumptions through discussions and a free exchange of ideas. In keeping with the University's goal of internationalization as captured in its vision ("by 2020, Åbo Akademi University will be a university that breaks linguistic and cultural boundaries, where the Swedish-speaking academic community is in full synergy with an international atmosphere, and where both education and research are of the highest quality" [Åbo Akademi University Website 2018]), the University hosts exchange students from Europe. The participants of the multilevel governance course comprised primarily of these exchange students with one Finnish student.

5. Results: active learning components utilized in the course redesign

The course redesign for "multilevel governance" was motivated by a desire to incorporate education for sustainable development (ESD) principles in the de-

livery of the course for enhanced student engagement. At the same time, a lot of pedagogical innovations were carried out quietly at Åbo Akademi University through courses designed to teach best practices in pedagogy to university lecturers. There was a collective momentum to move away from the traditional methods of reading courses, examined through one paper and the traditional lecture-based classroom. The goals of the 'multilevel governance' course redesign were to 1. Improve students understanding of and appreciation for sustainable development 2. Engage students as partners in their learning 3. Stimulate students' creativity through the use of digital methods such as Technology, Education and Design (TED) talks in the classroom and 4. Improve students' understanding and application of the theories multilevel governance in order to hone their critical thinking skills, problem solving skills and team interaction skills.

5.1. Offloaded content

The new course design utilized Moodle, an integrated learning platform, which was designed for educators to create a secure and personalized learning environment [Moodle 2018], to post lecture materials and communicate with students outside of the classroom. Ten course readings were preloaded to the course Moodle page at least one week prior to the start of class. Students were given rights to download the material and so were able to read at their own pace prior to the start of class. Material was carefully selected with links to sustainable development. One challenge in uploading material was to determine the right fit between the essential amount of reading for the students that would provide a theoretical foundation to the course and stimulate their interest without overwhelming them with too much reading material.

5.2. Micro-lectures and in-class group work

The micro-lecture is a modification of the traditional lecture to incorporate active learning activities throughout the classroom period. This was used by the lecturer to present foundational concepts in order to reinforce students' learning and, judging from the results of the in-class group work and activities, to redirect learning. The maximum duration of the micro-lectures was fifteen minutes, followed by an in-class active learning activity. These micro-lectures also provided an opportunity for the lecturer to redirect students' attention after the excitement of an active learning environment where there is a lively discussion and exchange of ideas. Students knew they could rely on added clarity and perspectives from

these bite-sized knowledge segments. Micro-lectures also provided students with the comfort of knowing that they can seek further answers from the lecturer, allowing them to extend and explore the topic further.

Students were also shown relevant videos in class that were pertinent to the subject being discussed and then broke off into group work to discuss and answer probing questions. For example, students were shown a video on the Integrated Rhine River program (www.youtube.com/watch?v=trPhVP8N6ng) and then asked to work in groups to discuss elements of multilevel governance that were shown in the video. They were asked whether those elements were working effectively and if not, what could be improved. There was much animated discussion and debate in the groups. At the end of the group work, students presented their thoughts to the rest of the class. There was much expanded discussion and sharing of different country perspectives, including those of students who lived in the Rhine River watershed. This brought home the value of using materials in class that are relatable to students to motivate their interest and to share personal experiences.

5.3. Think-pair-share activities

Each class contact period included several think-pair-share activities. In one such activity, students were presented with a discussion question that they spent a few minutes thinking about on their own and jotting the answers down. Then they turned to the person next to them and discussed their answers and came up with combined and consolidated answers. Students were eager to share their perspectives with other class members, which led to expanded discussion and feedback from the lecturer. As a simple example, students were asked to think about what the term sustainability meant. They were given a few minutes to think about their answers, and then they discussed answers with their neighbor and shared their combined answer with the class. This, as predicted, led to a lot of discussion and surprising answers about sustainability. Students reported that this exercise helped them to open their eyes to new aspects of sustainability, as students shared perspectives from their home countries.

5.4. Technology, Education, Design (TED) talks

The history of Technology, Education and Design (TED) talks can be traced back to a 1984 and Richard Wurman's conviction about the convergence between technology, entertainment and design. This developed further to the first TED conference (with Harry Marks), which included a demo of compact discs,

e-books, 3D movie graphics, and a demonstration by mathematician Mandelbrot on how to map coastlines using geometry [TED 2018]. Since 1990, the conference has become an annual event and broadened the list of topics and its influence by going online. In 2001, TED was acquired by media entrepreneur Chris Anderson of the nonprofit Sapling Foundation [TED 2018]. The first TED talks were shared on the Internet on June 27, 2006, amassing more than one million views by September 2006. Today, TED has evolved as a forum consisting of 'ideas worth spreading' taking the format of short (usually 18 minutes or less) influential talks. According to the website, TED is a "clearinghouse of free knowledge from the world's most inspired thinkers" [TED 2018]. Its mission as stated on the website is that, as a global community, "welcoming people from every discipline and culture who seek a deeper understanding of the world. We believe passionately in the power of ideas to change attitudes, lives and, ultimately, the world." TED talks can be accessed online through TED.com.

A search on the right hand side of the TED website for 'sustainable development' produced 89 results. Some of these results were used in class to listen to and discuss ideas from some of the world's most innovative speakers. Students were then asked to discuss the groups what worked well in the talks, what ideas most resonated and how the talk could have been improved. This helped in developing critical thinking and assessment skills in students. The lecturer then regrouped students and provided further clarification of ideas and summed up the elements of good TED talks. Students were introduced to their assignments, which was to produce a 5 minute TED talk on the subject of sustainable development from any perspective. One example talk from one of the students can be accessed here: www.youtube.com/watch?v=M65CH6q2Sl8&feature=youtu.be

5.5. Expert/industry guest lecturers

Guest lectures were carefully selected to present students with real world problems and applications of the principles they were already discussing in the classroom. Guest lecturers were selected from a broad disciplinary background and used varying techniques to engage the class in discussion. One expert lecturer had sent material prior to the class, which was uploaded to the Moodle course page for access before class. This content was then discussed with the class and solutions to real world problems also discussed. Another guest lecturer utilized group work to introduce the class to the problems that his organization faced and asked for solutions from a sustainable development and multilevel governance perspective.

There were a total of three guest lectures. The expert from the Union of Baltic Cities (network of cities in the Baltic Sea region) explored the role of the local

level in governance of sustainable development with students. Another guest, an ex-official from the Helsinki Commission (The Baltic Marine Environment Protection Commission- the governing body of the Convention of the Protection of the Marine Environment of the Baltic Sea Area, a convention signed by coastal countries for the protection of the Baltic Sea) engaged students on sustainable development in the Baltic Sea Region. The third guest facilitator was an official from Interact (an EU-funded programme to foster cross-border, transnational and interregional cooperation), who engaged students in a debate on the usefulness of macro-regional strategies in achieving environmental goals.

5.6. Teamwork

The class assessments were designed such that one component incorporated group work to allow students to develop team working skills. Each randomly selected group of five persons (different from the class discussion groups, which changed for each class) was assigned to groups and given a general topic and a period of four days to decide what aspect of the topic they would like to explore, conduct the research and report on it in class and in the final report. Groups were randomly assigned topics such as governance of sustainable cities, marine and water governance and governance of sustainable development. The instructor was present in the classroom for a certain period of time to act as a coach or mentor for group work. Groups reported that one of the hardest parts of the assignment was deciding on what aspect of the topic to focus on, as the topics were general. This showed that one of the aims of the exercise was achieved, namely that students were able to understand that ill-defined problems in the real world, such as climate change, are harder to solve than those narrowed down to one sector or area of society.

Students presented their results to the class in group presentations lasting 15 minutes each. Other groups were allowed to question each presenter and this lead to lively discussions and learning in class. Students were then asked to fill in peer group evaluation forms, where they had to rate group members' participation and contribution to the group work. Students reported benefits of working in a group included learning from different perspectives and being able to develop strategic and problem solving skills. Here is a sample of one student's experience of working in a group: "Working in the group showed me the different perspectives and ideas all of us had in our group concerning our topic".

They were also asked to reflect on their own participation and contribution. This encouraged self-reflection, and led to some useful insights. For example, one student wrote that: "I like to work in groups because it gives you an opportunity to test your ideas and thought processes before you start a project. Also, as the project

goes along, you have a lot better chances to get help or see problems more clearly, when you can discuss the process with your colleagues. Of course, working in a group puts you in a more responsible position because the work isn't only depending on your input, but in the other hand your input is as needed as the rest of the groups. With this I mean you have a responsibility towards your group to do your part, but also you can control your part a lot better, and not have to do everything."

6. Discussion

This paper presented a redesign of the course "multilevel governance" to include active learning elements to foster education for sustainable development skills in students. This section discusses how the active elements incorporated in the course were able to foster elements of ESD as defined by UNESCO. These elements are: "learning to ask critical questions; learning to clarify one's own values; learning to envision more positive and sustainable futures; learning to think systemically; learning to respond through applied learning; and, learning to explore the dialectic between tradition and innovation" [UNESCO 2011a: 8].

6.1. Learning to ask critical questions

The course was redesigned with the intent of fostering critical thinking skills in students. One sign of developing critical thinking skills is the ability to ask meaningful questions. This developed spontaneously through the active learning activities, as students listened to different perspectives from peers. In the beginning the lecturer modeled the behavior of asking questions by asking probing questions during group work, such as "What made you think that? Can you give an example that you know of? Does someone have an alternative opinion? Is there another possible solution to this problem?" As the class progressed, students were actively questioning each other and the lecturer and guest lecturers more and more. Questions were also utilized as a technique by students in their TED talks to engage the audience.

6.2. Learning to clarify one's own values

The guest lectures provided the perspective of the expert in the field. Students were able to question their assumptions about "what happens in the real world" as opposed to what's written in theory. The group activities in the classroom and outside of the classroom provided fertile ground for students to clarify and ques-

tion their own values. This was done through listening to different perspectives and critically questioning this in relation to the theory and material presented in class and in the world. This was captured in the words of one student: "I learned about looking from a different point of view. Because, when I study individually, I focus on just one issue. I wasn't looking in a different way. But, by working with a group, I learned much more information from others."

6.3. Learning to envision more positive and sustainable futures

The world is increasingly plagued by complex and challenging problems with no easy solutions and lecturers have a role to nurture students to think about and solve these problems. One of the ways students could envision a more sustainable future was through looking at TED talks. TED talks revealed worlds that consisted of best practices, breaking with tradition in favour of innovative solutions and solving complex problems through lateral thinking. In their own TED talks, it was clearly evident that students had acquired the skills of envisioning a more positive and sustainable future, as the majority of TED talks ended with a call to action for the audience to contribute to a more sustainable society.

Although it was not possible to present feedback from all the students here, one student captures how the course helped him to envision sustainable futures: "I expected to learn more about multi-level governance systems and theories. Also, the practical applications of these solutions interest me. I believe it is very important when I myself construct my theories and hypothesis in my master thesis, that I know as much as possible of all the different real solutions in this case. The sustainable development part of the course is in my view a bonus. I argue that if we ever want to achieve truly sustainable solutions, governance models should follow cooperative systems and policies. Only if we work together and understand each other, and where we want to be, can we make society a much more healthy and better place for everybody."

6.4. Learning to think systematically

Learning to think systematically entails being able to approach an issue from a holistic perspective, examining the interrelationships between its parts and not merely thinking about individual components. This entire course was designed to help students grasp the interconnectedness of the modern world. The very definition of multilevel governance highlights the interconnectedness of the governance system. Multilevel governance can be defined as [OECD 2011].

"The explicit or implicit sharing of policymaking authority, responsibility, development and implementation at different administrative and territorial levels, i.e., (i) across different ministries and/or public agencies at central government level (upper horizontally); (ii) between different layers of government at local, regional, provincial/state, national and supranational levels (vertically); and (iii) across different actors at the sub-national level (lower horizontally)."

Through the analysis of multilevel governance structures and their implications for society, students were forced to see the interrelatedness of issues. Topics of sustainable development that were explored in class and through the guest lectures highlighted its multidisciplinary nature. Topics covered economic, cultural, environmental aspects and included many sectors including transportation, business, agriculture, engineering, and law and also examined short, medium and long-term perspectives from the local, regional and international levels. The active learning techniques used in the classroom were carefully designed to enable students to appreciate the complexity, interrelationships and the global picture. Students were able to link their own lifestyles to consequences and influences from the local, regional and international level. Although all students were from the European Union, they were able to appreciate the differences in country contexts and the interrelationships through class discussions.

6.5. Learning to respond through applied learning

Students were able to apply their learning through the assignment and research activities. For example, for group work, students chose their own topics from the general guidelines. Students then explored these cases and applied the theory gained in class to the analysis of their case studies. This was clearly evident in the final presentations, as students began with the question they were researching and the methodology utilized in answering the question. Students were also able to apply their knowledge to answering group questions on videos looked at in class and in answering questions posed by the lecturer on the spot in class.

6.6. Learning to explore the dialectic between tradition and innovation

The subject matter of the course lends itself readily to explore the dialectic between tradition and innovation. Traditionally in the Baltic Sea Region, governance was mainly done by governments. The Helsinki Convention arose through governmental diplomacy during the Cold War period but gradually expanded to

broaden in focus and scope to include non-governmental actors and other issues. Governance refers to the steering of society by actors other than government, including civil society, the private sector and nongovernmental organizations. Students examined the evolution of government to governance, recognizing that society's problems are so complex that they can only be solved when different perspectives and knowledge is brought to the table through wider participation. Whilst in the past governments were seen as the authority that solves social problems, students were able to appreciate through the topics discussed that wider participation can lead to innovative solutions.

7. Conclusion

Education for sustainable development aims to disrupt the preconceptions of students in higher education, making them uncomfortable with rote learning and to provide them with knowledge and skills that can solve real world problems in an innovative manner. Recognizing this, the course on 'multilevel governance' taught at Åbo Akademi University, Finland was redesigned to better foster these skills. At the core of the new format was the incorporation of active learning techniques into the classroom and beyond for the students. Active learning techniques have proven to effectively engage students in the material, making them partners in their learning. Active learning activities, such as prior offloaded course content, group work, TED talks, think-pair-share and guest lecturers, were introduced in the flipped classroom format for 'multilevel governance'. Students reported increased awareness and understanding of sustainable development issues and this was captured in the 5 minutes TED talks submitted as part of the course assessment.

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Uczenie się aktywne jako środek promowania edukacji na rzecz zrównoważonego rozwoju w klasie: przykład wdrażania kursu „Wielopoziomowy ład organizacyjny"

Streszczenie. Świat staje się coraz bardziej złożony i staje w obliczu wyzwań związanych z poważnymi problemami, takimi jak zmiany klimatyczne, które nie mają prostych rozwiązań i dotyczą wielu interesariuszy reprezentujących sprzeczne interesy. Szkolnictwo wyższe odgrywa istotną rolę w wytyczaniu kierunków dla społeczeństwa w tych wymagających warunkach. Kształcenie nowego pokolenia specjalistów oraz osób, które będą zmieniać oblicze świata według zasad zrównoważonego rozwoju, otwiera drogę ku znalezieniu równowagi między zagadnieniami środowiskowymi, społecznymi i ekonomicznymi. Edukacja na rzecz zrównoważonego rozwoju musi wyposażyć studentów w umiejętności myślenia niestereotypowego i krytycznego w celu tworzenia kreatywnych rozwiązań aktualnych problemów. Choć uznaje się potrzebę rozwijania pedagogicznych podejść do zasad zrównoważonego rozwoju w edukacji, istnieje luka w literaturze na temat przykładów działań pedagogicznych promujących edukację na rzecz zrównoważonego rozwoju. Niniejszy artykuł ma na celu wypełnienie tej luki poprzez analizę aktywnego uczenia się jako środka promowania edukacji na rzecz zrównoważonego rozwoju w klasie. Autorzy opisują zastosowanie technik aktywnego uczenia się w kursie „Wielopoziomowy ład organizacyjny". Wśród zalecanych technik omówione są dyskusje w grupach, zadania grupowe, referaty TED, które służą zwiększeniu zaangażowania studentów w podejmowanie zagadnień zrównoważonego rozwoju.

Słowa kluczowe: aktywne uczenie się, region Morza Bałtyckiego, ład organizacyjny, edukacja na rzecz zrównoważonego rozwoju, odwrócona klasa

Studia Periegetica nr 3(23)/2018
DOI: 10.26349/st.per.0023.04

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Framework for Transformation of the Mathematics Education into Education for Sustainable Development[1]

Abstract. A good quality education is an essential tool for achieving a more sustainable world. According to the UNESCO, mathematics is an instrument for sustainable development and particular attention should be paid to mathematics education. For that reason, the objective of this study was to create a framework for transforming mathematics studies at the university into education for sustainable development and describe a change project which includes three steps: assessment of existing practice, how university is meeting demands of sustainable development as well as description of the change project idea. The article describes factors influencing the development of maths education at Latvia University of Life Sciences and Technologies, compliance of maths education with the demands of sustainable challenges, as well as initiatives to transform maths education into education for sustainable development which is based on UNECE Strategy for ESD.

Keywords: education for sustainable development, engineering education, mathematics education, stakeholders' cooperation, sustainable development

1. Introduction

A good quality education is an essential tool for achieving more sustainable world. This was highlighted at the UN World Summit in Johannesburg in 2002, underlining the reorientation of current education systems as a key for sustain-

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[1] The author expresses gratitude to the teachers and organizers of the Baltic University Program Teachers' Course on Education for Sustainable Development in Higher Education for the given opportunity to take part in this course. This article was created within the framework of the LLU program's "Strengthening the Scientific Capacity in the LUA" project Z32.

able development (SD). In accordance with UNESCO documents, education for sustainable development (ESD) is understood as education that "empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for present and future generations, while respecting cultural diversity" [UNESCO 2004]. It contributes to the development of the knowledge, skills, awareness, values and activities needed to create a sustainable world and teaches individuals how to make decisions that consider the long-term future of the economy, ecology and equity of all communities [UNESCO 2008].

In September 2015, the United Nations (UN) General Assembly adopted 17 Sustainable Development Goals (SDG), one of which is to ensure inclusive and equitable quality education and promote opportunities for lifelong learning [United Nations 2015]. Target 4.7 of the SDG 4 by 2030 envisages to ensure that all learners acquire the knowledge and skills needed to promote SD, developing and modernizing educational institutions that provide a safe and efficient learning environment for all [Sustainable Development Goals 2015]. One of the most effective and effective ways to achieve SDG 4.7 is to embed ESD in key subjects, such as mathematics.

Mathematics plays a very important role in sustainable development. According to the UNESCO, maths is an instrument for sustainable development, because in mathematical activities (counting, measurement and location), people develop ways to effectively meet their needs, indicating a clear link between people and the environment [UNESCO 2017].

Taking into account the above-mentioned aspects, it is necessary to improve mathematical education in line with sustainable development trends. Therefore, the objective of this change project was to create a framework for transforming mathematics studies at a university into education for sustainable development with the aims:

– to activate the role of mathematical competences in the context of sustainable development in Latvia with the focus on employment and sustainable socio-economic development, as well as mathematics as an instrument to tackle environmental challenges;

– to conduct a study of the situation and to identify a set of measures to ensure that maths education meets the criteria for the development of educational sustainability.

The project idea was based on the author's experience in the development of mathematical education at the Latvia University of Life Sciences and Technologies (LLU) during the last decade.

2. Materials and methods

The methodology applied in the project includes scientific/educational support, providing assistance in the form of learning from experiences, developing a collaborative community and shared responsibility in non-formal and informal education, competence-based curriculum development for education and sustainability, etc. Based on the analysis and evaluation of the scientific literature and a number of information sources and reports, as well as taking into consideration the author's reflection experience and observations, several aspects were considered in the project:

– Systematicity – logically structured, systemic or hierarchically subordinate analysis and synthesis, organization and implementation of systemic activities;
– Multidimensionality – taking into account various dimensions;
– Integrity – covering various stakeholders and areas;
– Partnership - joint development, joint planning, aligned research; etc.

The structure of this article corresponds to the structure of the development project which includes three steps:

– Assessment of the existing practice – current teaching and learning transformation to meet sustainability challenges;
– How mathematics education in LLU is meeting these demands – what is working well and what is not working so well;
– Author's vision of a change in mathematics education in Latvia University of Life Sciences and Technologies.

3. The experience of LLU in the implementation the Strategy for ESD

Assessing the activities undertaken by LLU and the proposed initiatives to improve the course of mathematics, it must be acknowledged that the measures were taken in line with the UNECE Strategy for education for sustainable development [UNECE Strategy 2005], which aims to equip people with knowledge, skills, understanding, attitude and values compatible with sustainable development. This document outlines ways to develop and incorporate ESD into formal education systems, in all relevant subjects, and in non-formal and informal education, by promoting SD through formal, non-formal and informal learning, equipping educators with the competence to include SD in their teaching, ensuring that adequate tools and materials for ESD are accessible, promoting research on and development of ESD and strengthening cooperation on ESD at all levels.

LLU prepares mainly engineering and technology specialists for the needs of the region. Engineering relies heavily on mathematics. Various studies show that engineering as a profession requires a clear understanding of mathematics, sciences and technology, but engineering graduates have to acquire not only a practical but also abstract understanding of mathematics [Pale 2001: 170-171; Sazhin 1998: 145-152]. Therefore, in LLU many higher education courses are mathematics-intensive, and at present higher mathematics is included in all the study programs offered by LLU in the amount of 7.5 – 16 ECTS with the aim to acquire the mathematical knowledge and skills needed for the further studies of special professional subjects. The university's vision is to become one of the leading science and technology universities in the Baltic Sea Region with a specialization in the sustainable use of natural resources for raising the society`s quality of life. Therefore, the Department of Mathematics of LLU sees its mission as promoting the development of mathematics education in the region, and also providing space and opportunity for school and university math teachers to communicate, share knowledge, exchange experience. Thus, cooperation with other technical universities in Latvia and in other Baltic States has been established and several cooperation networks have been created for the implementation of this mission: Baltic Network in AGROMETRICS, Latvia-Lithuania cross-border network for adapting mathematical competences in the socioeconomic development (MATNET) and a cross-border network for raising competencies in data analysis technologies (LV-LT-BY DATA ANALYSIS), as well as the cooperation with study program directors, professional associations, employers, authorities, school mathematics teachers, etc. [Vintere 2017: 174-185]. That is why in this change project the term "mathematical education" is used instead of the term "higher mathematics studies at a university."

To summarise the activities for the implementation of the Strategy for ESD, "input indicators" proposed by UNECE [2008] were used, but sub-indicators were determined based on "Phase III: Format for reporting on the implementation of the UNECE Strategy for Education for Sustainable Development" [UN Economic Commission 2014]. Thus, the current development of LLU mathematical education can be characterized by the following indicators and sub-indicators [Vintere 2017: 174-185]:

– promote SD through formal, non-formal and informal education: curriculum development, quality assessment/enhancement, extra-curriculum activities – facilitate acquisition additional skills needed for sustainable development, mathematics continuing education in the context of life-long learning;

– equip educators with the competence to include ESD in their teaching: capacity-building and exchange of experiences;

– teaching tools and materials: study materials availability;

– research on ESD: public awareness-raising.

The implementation of the Strategy for ESD has been based on three strategies:
- subject: mathematics – based approach;
- multi-stakeholder approach;
- ICT based.

More about the implementation of the Strategy for ESD in "Implementation of the Education for Sustainable Development Strategy in the Mathematics Education through Stakeholder Cooperation" [Vintere 2017: 174-185].

4. Compliance of the LLU mathematics education with the demands of sustainable challenges

Compliance is assessed in two dimensions: what is working well and what is not working so well.

What is working well? Activities in four areas can be assessed as working well, namely: cooperation, dialogues, activities on curriculum development and quality enhancement as well as extra-curriculum initiatives supporting the acquirement of competencies necessary for SD.

As mentioned above, LLU is involved in different cooperation networks. Based on her experience in scientific and international projects, the author has identified two cooperation levels: international and local. Cooperation can be implemented through cooperation with other universities and with professional institutions [Vintere 2013: 354-361]. Experience shows that cooperation with universities is implemented through a university profile or through a particular level (local, regional, European/Life Sciences, etc.). Both international and local cooperation can be implemented also by study programs in particular areas (e.g., civil engineering, rural engineering).

International cooperation in research and development, and cooperation with other international organizations provide opportunities for the exploration, discussion and exchange of education ideas, analysis of common problems, implementations of European dimension in mathematics education. In turn, research partnerships can promote knowledge production and sharing and create synergies and complementarities among the diverse participants for mutual benefit [Mandaviya & Dwivedi 2016: 312-320].

At the local level, LLU has developed productive cooperation with other higher education institutions and high schools/gymnasium mathematics teachers. Experience exchange seminars and professional development courses are regularly organized. Another positive point worth mentioning in the context of various projects and initiatives is the fact that LLU has developed a good dialogue with different stakeholders:

– With study program directors (what, why, how to teach);

– With employers (competencies needed for specialists, reals situations/ tasks to be solved by students; summer school on math application in real life context...);

– Society (math competences in the context of lifelong learning, math in professional activities, math continuing education, opinion how to promote math competence in Latvia, etc.).

UNESCO Report (Delors at al. 2001) indicates that education should be organized according to the four basic principles:

– Learn to know – to develop critical thinking, learn instruments to understand world;

– Learn to do – knowledge, values and skills to be able to use the acquired knowledge in everyday life, etc.;

– Learn to live together – to attend and participate in all human activities along with other people;

– Learn to be – knowledge, values and skills for well-being, to develop personality, to make independent decisions, to take responsibility, etc.

This also poses a new challenge for maths studies. To respond to it and contribute to the development of the professional and social competence two sustainable initiatives had been launched by LLU and Siauliai University within the Latvia -Lithuania cross-border cooperation project „Cross-border network for adapting mathematical competences in the socio-economic development": High School Pupil Scientific Mathematics Olympiad (HSPSMO) and International Student Scientific Mathematics Olympiad (ISSMO). Although the project was completed in 2013, the Olympiads are held every year and the number of participants is steadily rising. The main objectives of these Olympiads are to encourage talented pupils and best students in their study of mathematics, to motivate them to pursue a career in this field and adapt their knowledge and skills by gathering them together and by creating the conditions to share scientific and cultural experience. The Olympiads promote mathematics among young people; strengthen the knowledge obtained at school, provide an opportunity for its creative application; encourage students to think "out of the box," develop cooperation between young people with similar interests, etc. Opportunities for students to communicate about mathematics are provided in a supportive environment that can deepen mathematics understandings and meaningful studies at universities.

What is not working so well? In scientific literature sustainability in higher education is characterised by different concepts [Ferrer-Balas et al. 2008: 295- 316]:

– transformative education aimed at preparing students capable of addressing complex sustainability challenges and the process of learning, which is more interactive and learner-centric, with a strong emphasis on critical thinking ability;

– inter and transdisciplinary research and science;
– societal problem-solving orientation in education and research etc.

It should be noted that mathematics has a special role to increase the capacity of the university in preparation of new professionals in line with the development trends of society as well as getting competencies for living and working in the changing world with focus on employment and sustainable socio-economic development, as well as seeing mathematics as an instrument to tackle environmental challenges. Complex problem solving, critical thinking, creativity, decision making, cognitive flexibility – these are the competences most often referred to as a key element of sustainable development, and they can be developed through mathematical education. According to Serve [Serve 1957: 22-32], mathematics develops logical thinking that includes the ability to think deductively, abstract, generalize, classify, analyse, criticize. Mathematics is considered as a unique way of interpreting human thoughts.

In spite of the above, several studies have shown [Rylands & Coady 2009; SEFI 2002; Moyo 2013] that the quality of mathematics studies is decreasing and the level of students' preparation and knowledge is getting worse. There are some important factors that affect the development of maths education for engineers in Latvia: despite the fact that the maths contents of general engineering studies at the author's university has not changed for several years, the amount of time devoted to it is decreasing. Moreover, the problem is that the curriculum has evolved through addition not redesign. At present, maths curriculum is specified in terms of four aspects: the course aim; specification of mathematical content - lists of the mathematical topics; outcomes to be achieved; forms and instruments of assessment and testing [Vintere & Briede 2016: 1121-1127].

The second problem is that students' previous knowledge of mathematics is low. Taking into account the author's experience, it can be concluded that the overall competence in mathematics has not increased during the latest years and students' abilities are getting worse and worse.

Mathematical competence is one of the eight key competencies defined by EU Directives, which include the skills to apply basic math principles and processes in everyday contexts. However, students in Latvia tend to have a narrow view of what maths is and fail to see its connection to the world around them. For many such students, maths is only a set of formulas to be learned and manipulated in order to obtain numerical answers. In the teaching process, the emphasis is usually placed on problem solving techniques and procedures and little attention is paid to the purposes behind the formulas or to the interpretation of numerical results [Vintere 2018: 18]. What students are actually interested in is getting a detailed explanation of how particular mathematical calculation techniques are applied in the real life context.

According to textbooks for pedagogues, curriculum leaders and ministries of education published by UNESCO [2017], mathematics is seen as a tool to promote the idea of sustainable development of society, where it is pointed out that understanding mathematics makes it possible to think about how it can either support or undermine sustainable development. The initiatives described in this document could be transferred to courses of higher mathematics in universities taking 15 goals of UN as a real life content basis. At present it is a challenge.

5. Author's vision for change in mathematics education in LLU

On the basis of the above, the author sees the target audience as two groups: internal and external. The internal target group consists of students studying higher mathematics, academic staff (teachers of mathematics, professional subjects, etc.), study program directors/university management, etc.

As this change project relates not only to mathematics studies at university, but to maths education in general, three groups of external target audience can be identified:

1. Labour market:
– professionals who use maths in professional activities,
– employers.
2. Local society:
– school pupils,
– maths teachers,
– people who need to increase maths skills for daily use.
3. Local/regional/national planning institutions, policy makers, etc.

To transform maths education into education for sustainable development, based on experience and activities already implemented, the author of this article has developed a systematic and easily adaptable framework for activities that include:

1. Develop and implement methodology for identifying and evaluating the **needs of mathematical competences/education** (from the perspective of students, university/programme management, employers, policy makers, individuals).

2. Substantiate the **importance of mathematical education** in forming a specialist's competence in the context of sustainable development of society.

3. Develop and implement **indicators** of mathematical competence in relation to the competences necessary for sustainable development.

4. Create and implement a **didactic model** of mathematical education in order to promote the development of mathematical competences for sustainable development which includes:

– math **study process organization** at university,
– determination of the **content** of the course,
– defining content **organization forms**,
– the choice of teaching **methods**,
– testing and **assessment**,
– the study result to be achieved – **outcomes**;

5. Provide **non-formal/informal learning opportunities for students** to increase math competencies.

6. Develop a **strategy for the professional development of academic staff** and implement it.

7. Provide a customized **non-formal educational support for adults** to promote getting competencies for living and working in changing world with main focus on analytical/system thinking/problem solving/cognitive flexibility/critical thinking skills, etc.

8. Encourage and motivate **talented pupils** to adapt mathematical knowledge and skills and create conditions for sharing their scientific and cultural experience.

9. Enhance **cooperation between school teachers and university lecturers** to share good experiences, which could stimulate the development of fundamental sciences needed for sustainable development of Latvia.

10. Establish a relationship between the **university and employers**:
– maths education needs in different professional fields,
– to organize employee skills upgrading programmes in the workplace.

11. Cooperate with **industry** for the application and transfer of mathematical knowledge.

A group of researchers has been set up at the LLU, which also includes the author of this article. At present, this group is developing a methodology for identifying and evaluating the needs of mathematical competences and course content from the perspective of all stakeholders and is conducting a study on ways of developing a competence-based curriculum and mathematical teaching methods that are consistent with sustainable development.

6. Conclusions

1. In LLU initiatives to transform maths education into education for sustainable development based on UNECE Strategy for ESD.

2. The implementation of this strategy in maths education was measured by four input indicators, based on the objectives of the UNECE Strategy for ESD: promoting sustainable development through formal, non-formal and informal

education, equipping educators with the competence to include ESD in their teaching, teaching tools and materials and research on ESD.

3. Next step – focus on development of competence-based curriculum for educating for sustainability: determination of the content of the course and teaching methods based on the constructivist approach to teaching to develop mathematical competence and also boost competences needed for SD.

4. Value that the project will bring to the university:

– increased capacity of the university in the preparation of young specialists in accordance with the development trends of society as well as getting competencies for living and working in changing world;

– in-depth knowledge and introduction of new practice in the implementation of education for sustainable development in the study process. Created a precedent that is useful and can be adapted to improve other areas of study;

– improved academic staffs' professional capabilities to enhance mathematical competence to increase the competitiveness in the labour market and personal resilience;

– enhanced cooperation between higher education stakeholders to create high-quality higher education offerings and to contribute to the development of lifelong learning.

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Ramy koncepcyjne dla przekształcenia nauczania matematyki zgodnie z zasadami edukacji na rzecz zrównoważonego rozwoju

Streszczenie. Kształcenie dobrej jakości to konieczne narzędzie do osiągnięcia bardziej zrównoważonego rozwoju na świecie. Według UNESCO matematyka to narzędzie zrównoważonego rozwoju, dlatego należy zwracać uwagę na kształcenie matematyczne. Celem artykułu jest opracowanie ram koncepcyjnych umożliwiających przekształcenia nauczania matematyki zgodnie z zasadami edukacji na rzecz zrównoważonego rozwoju oraz opis projektu zmiany składającego się z trzech etapów: oceny aktualnych praktyk; tego, jak uczelnia realizuje wymagania w zakresie zrównoważonego rozwoju, oraz opisu koncepcji projektu zmian. Artykuł przedstawia czynniki wpływające na rozwój kształcenia matematycznego na Łotewskim Uniwersytecie Rolniczym w Jełgawie, zgodność nauczania matematyki z wymaganiami zrównoważonego rozwoju oraz inicjatywy, których celem jest przekształcenie nauczania matematyki zgodnie z zasadami edukacji na rzecz zrównoważonego rozwoju na podstawie strategii zaproponowanej przez UNESCO.

Słowa kluczowe: edukacja na rzecz zrównoważonego rozwoju, kształcenie inżynieryjne, nauczanie matematyki, współpraca interesariuszy, zrównoważony rozwój

Studia Periegetica nr 3(23)/2018
DOI: 10.26349/st.per.0023.05

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Sustainability at Higher Education Institutions of Belarus: Case Study

Abstract. The article deals with the organization of network activities in the field of education as one of the most important forms of international cooperation among the universities of the Republic of Belarus. The authors describe the largest networks of associations and universities. The direct participation of Yanka Kupala State University of Grodno in the national and European educational space is analyzed using examples of networking. The emphasis is placed on the importance of implementing university network priorities aimed at fostering education for sustainable development in cooperation with Belarusian universities.

Keywords: education for sustainable development, international cooperation, higher education, university cooperation, network activities, university networks, networks of associations

1. Introduction

Our region is an exceptional eco-region not only because of its geographical and historical characteristics, its unique natural and cultural heritage, but also thanks to the feeling of belonging to "the Baltic region," shared by its inhabitants. Located at the meeting point of the three borders, the region brings together countries and peoples of different levels of economic and social development, different religions, languages and cultures, that share a common heritage, created throughout

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centuries of old 'exchanges' of all kinds. These characteristics render the Grodno region a perfect illustration of the global situation.

Education for sustainable development (ESD) requires a reorientation away from focusing entirely on providing knowledge towards forms of dealing with problems and identifying possible solutions. Therefore, education should retain its traditional focus on individual subjects and at the same time open the door to multi- and interdisciplinary examination of real-life situations. This could have an impact on the structure of learning programmes and on the teaching methods, requiring educators to stop being merely transmitters of knowledge and learners to stop being merely knowledge recipients. Instead, both should form a team.

Formal education institutions play an important role in developing capacities from an early age, providing knowledge and influencing attitudes and behaviour. It is important to ensure that all pupils and students acquire appropriate knowledge of sustainable development (SD) and are aware of the impact of decisions that do not support it. The educational institution as a whole, including pupils and students, teachers, managers and other staff as well as parents, should follow the SD principles.

It is important to support non-formal and informal ESD activities, since they are an essential complement to formal education, not least for adult learning. Non-formal ESD has a special role to play as it is often more learner-oriented, participatory and promotes lifelong learning. Informal learning in the workplace adds value for both employers and employees. Therefore, cooperation among different actors involved in all forms of ESD should be recognized and encouraged.

Belarus is a member of the Eurasian Economic Community, the Collective Security Treaty Organization, the international Non-Aligned Movement since 1998, the Organization on Security and Cooperation in Europe (OSCE), and the UN since its founding in 1945. Belarus is included in the European Union's European Neighborhood Policy (ENP), which aims at bringing the EU and its neighbors closer.

For the past decade, Belarus has focused its efforts primarily on ensuring social stability in a challenging environment of transition from one economic model to one conditioned by today's globalized world. The socially-oriented economic development model has helped to preserve the industrial potential and avoid a sharp increase in poverty, but this improvement has not yet led to positive changes in environmental security, in the aftermath of the Chernobyl disaster and the high deterioration of industrial fixed assets.

Belarusian ESD practice is at a relatively early stage of development, which is limited by the lack of a national strategy and program for ESD development that would encompass all levels of formal education, non-formal and informal learning. Despite a number of successful projects in ESD implemented with the support of EU, UNDP, the Support Program of Belarus of the Federal Govern-

ment of Germany and other international programs, there are still problems with openness and flexibility of the education system and enhancing the role of education in the sustainable development processes of the regions [National Strategy for Sustainable Socio-Economic Development of the Republic of Belarus Until 2030].

2. Sustainability for 21st education's needs at Yanka Kupala State University of Grodno

Sustainable development, and the process of institutional transformation this requires, remains a considerable challenge for universities. Worldwide, only a few universities are confronting these challenges. Through its initiatives "Agenda 21" and through the Department of Ecology, Yanka Kupala State University of Grodno has been among the first Belarusian universities to view the institution as a whole and to attempt to initiate processes in all working areas which point the way towards the integration of sustainability into each of the different areas in which it is active.

In this paper the focus is placed on the following question: how can universities actively face the challenges associated with sustainable development, and to what extent can targeted structural changes perform a contribution to transforming universities for sustainability? The University administration of Yanka Kupala State University of Grodno encourages research into ESD. This has increased cooperation and partnerships between stakeholders in research and development activities, ranging from identifying issues to working with new knowledge and making it known and used. The results of research and development efforts are discussed with actors locally, regionally and globally, and are incorporated into different parts of the education system, experience and practice.

Yanka Kupala State University of Grodno tries to ensure that all pupils and students acquire appropriate knowledge of SD and are aware of the impact of decisions that do not support sustainable development. An educational institution, as a whole, including pupils and students, teachers, managers and other staff as well as parents, tries to follow SD principles.

All this shows us the necessity of a new way not only of teaching but also of learning. The individuality of student should be on priority. It is important to teach him to find his own way of solution each problem. The multi- and inter-disciplinary examination of real-life situations need from the teacher to be creative.

Against this backdrop, it is worth asking to what extent the experiences gained and the knowledge acquired through these projects could be transferred to other universities or could provide support for them. In order to better understand this

transfer and its associated challenges, reference will be made to the findings of higher education research.

3. Environmental co-operation of universities as part of a regional framework for environmental management

The education sector consists of a broad field of actors with different regulatory management systems in different countries. It is also geared to cater for the needs of people of different ages and in different life situations. Cooperation, shared responsibility and leadership of all relevant state bodies should be recognized as an important mechanism for good governance and should be strengthened. Universities should cooperate and take the lead in initiating and encouraging further integration of SD concerns into formal education policies, programmes and curricula at all levels.

Such universities in Belarus as Yanka Kupala State University of Grodno (GrSU), and Belarusian State Pedagogical Maxim-Tank- University (BSPU), Belarusian State University (BSU), have organized a community of professionals, institutions and organizations, established with an aim to promote Education for Sustainable Development (ESD) into all areas of society, as well as to integrate the Belarusian experience of ESD practices into the international network of regional centres of expertise (RCE).

Our vision is to implement the education for sustainable development as a system innovation project. This is a unique opportunity to strengthen education as a social institution.

We can do it only if we have a professional and expert support in the promotion of the SDGs and ESD practices in educational, economic, ecological and social areas on the national, regional and local levels of government in Belarus.

To achieve these goals, the universities have focused their activities on the following tasks:

– to reorient the main attention from the provision of knowledge to working out problems and finding possible solutions;
– to change teaching methods and curriculum structure;
– to find new opportunities for a more multilateral and systemic approach;
– to promote the development of knowledge and special skills in the field of SD, increase their competence.

Based on the foregoing, we can argue that the introduction of ESD in higher education institutions involves the identification of innovative forms, new sustainable development issues.

As the most optimal innovative forms of education, contributing to the formation of sustainable development of society, we can consider the following forms:

– traditional (information-receptive) learning;
– learning through discovery or guided discovery learning;
– learning through active student participation or involved learning (participatory learning);
– problem-based learning;
– interdisciplinary education;
– online learning.

The use of these forms allows you to stimulate students' cognitive activity and achieve better results.

4. The student voluntary environmental movement "Green sun"

The process of implementing the principles of sustainable development in the educational process through the organization of voluntary environmental movement «Green sun» is actively carried at the Faculty of Biology and Ecology. Minimal involvement of students in unified eco-educational space, which is formed with the participation of social organization, can significantly improve the level of the individual components of a positive attitude to nature; it promotes the development of student initiatives, drawing attention to environmental problems, filling the information deficiency on this or that environmental problems. The activities of the voluntary environmental movement "Green sun" are based on the principles of sustainable development and the Earth Charter, fairness, transparency, democratic participation, respect for human rights and gender equality.

The volunteers want students of our university and others studying in the region to recognize the value of nature and treat it with care and respect, and to have the competencies and effective mechanisms of participation in environmental decision-making. They actively cooperate with civil society organizations, government, academia communities, as well as business companies sharing our concerns about the environment in Belarus.

Here are some of the activities undertaken by the "Green Sun":

– Environmental actions: "Grodno is our city." The main goal of the event is the formation of a new type of person with a new ecological thinking, able to understand the consequences of their actions in relation to the environment. Target group – students of secondary education.

– Roundtable on the topic "Education for sustainable development of the region: experience and prospects." Target group – representatives of the city authorities, the staff of educational establishments, youth and environmental

organizations. Goals – education in the subject of sustainable development, exchange of experience, development of cooperation.

– Yanka Kupala state University of Grodno organized a webinar entitled "The introduction of the ideas and principles of sustainable development." The purpose of the seminar – discussion of the possibility of extending the principles of sustainable development in the educational environment through interactive methods of education.

The challenge is how best to use their experience and potential to promote ESD. Another challenge is research into ESD-related issues, which still does not have a prominent role in the region. There is also a need for international cooperation on ESD in pre-school and school education. ESD uses tools that stimulate a change in behavior. With the tasks it fulfills, ESD shapes attitudes and integrates various spheres of human activity. It also improves such abilities as communication, systemic thinking, critical thinking and cooperation [Hopkins & McKeown 2002: 19].

Regional and subregional forums that bring together members of the education community, such as civil servants, educators and researchers, and other relevant actors to share their experience and good practices on SD- and ESD-related issues should receive high priority.

Educators, leaders and decision makers at all levels of education need to increase their knowledge about education for sustainable development in order to provide appropriate guidance and support. Therefore, competence-building efforts are necessary at all levels of both formal and non-formal education [Urea 2015: 228-233].

Key actions to achieve this could involve stimulating competence development for staff in the education system, actions for leaders to increase their awareness of SD issues; developing criteria for validating professional competence in ESD and incorporating them in staff evaluation and; introducing and developing management systems for SD in formal educational institutions and non-formal education settings; including SD-related issues in training and re-training programs for educators for all levels of education; and encouraging educators, including those involved in non-formal and informal education, to share experiences. The competences in ESD for educators as developed by the relevant UNECE Expert Group should be considered.

5. Conclusion

Education for sustainable development is part of the general educational transformation to enable every new generation to humanize living conditions. This is based on a definition of education "which emphasizes the self-driven devel-

opment and self-determination of human beings in a discourse with the world, other people and themselves" [Thomas & Muga 2014: 512]. In this context, education for sustainable development refers to the human capability of taking part in the shaping of society in an informed, reflective, and responsible manner, with a view to sustainable future development.

Questions as to how the future may be designed with a view to sustainable development at the local, regional, and global levels are systematically addressed in concrete activity areas. This means learning on the basis of real-life situations through exact observation, critical analysis.

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Zrównoważony rozwój szkolnictwa wyższego na Białorusi: studium przypadku

Streszczenie. W artykule przedstawiona została organizacja zintegrowanych działań w sferze edukacji na rzecz zrównoważonego rozwoju, która jest uważana za jeden z najważniejszych form współpracy między białoruskimi uniwersytetami. Autor zwraca uwagę na największe sieci stowarzyszeń i uniwersytetów. Analizuje udział Grodzieńskiego Uniwersytetu Państwowego im.

Janki Kupały w krajowej i europejskiej przestrzeni edukacyjnej poprzez budowanie i utrzymywanie rozległej sieci wzajemnych kontaktów. W artykule zwraca się uwagę na znaczenie realizacji priorytetowych kierunków działań wspierających edukację na rzecz zrównoważonego rozwoju we współpracy z białoruskimi uczelniami.

Słowa kluczowe: edukacja na rzecz zrównoważonego rozwoju, współpraca międzynarodowa, szkolnictwo wyższe, współpraca międzyuniwersytecka, organizowanie sieci działań, sieci uniwersyteckie

Studia Periegetica nr 3(23)/2018
DOI: 10.26349/st.per.0023.06

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ESD Implementation in Universities of Central and Eastern Europe: Common Barriers, Challenges, and Solutions for Kyiv and Riga

Abstract. The paper provides an overview of Education for Sustainable Development (ESD) evolution and implementation barriers in universities of Central and Eastern Europe (CEE), focusing on challenges to the incorporation and institutionalization of ESD in two leading universities: Riga Technical University in Latvia and National University of Kyiv-Mohyla Academy in Ukraine. A generic matrix of options for integrating sustainability in higher education is developed to analyze and extend previous research on ESD for CEE countries. A number of common barriers is indicated and possible solutions proposed for an effective implementation of ESD in university curricula.

Keywords: education for sustainable development, Central and Eastern Europe, educational barriers, sustainable development goals

1. Introduction

As commonly known, thirteen years ago the United Nations (UN) launched the Decade of Education for Sustainable Development (ESD) to enhance the role of education in promoting sustainable development Many international institutions nowadays recognize ESD as an integral part of quality education and a key driver of sustainable development; as stated in the UNESCO Roadmap for Implementing the Global Action Programme on Education for Sustainable Development (2014), "ESD is holistic and transformational education which ad-

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dresses learning content and outcomes, pedagogy and the learning environment" [UNESCO 2014].

The 2030 Agenda for Sustainable Development, adopted by UN in 2015, with 17 SDGs and 169 associated targets, serves as a continuation of ESD enforcement and further dissemination. It is not only formulated as a stand-alone goal – Sustainable Development Goal 4, but also incorporated in numerous education related targets and indicators of other Sustainable Development Goals [UNESCO 2017].

Although universities and other institutions of higher education are regarded as drivers of sustainable development, many of them are tackling sustainability issues in a compartmentalized manner, adding ESD related topics to specific courses, hardly trying to link ESD to university and campus operations by adopting a "whole-of-university" approach to sustainability [Mcmillin & Dyball 2009]. Adomßent et al. [2014] analyzed two hands-on examples from the Czech Republic and Bulgaria on ESD and concluded that the incorporation of ESD into CEE curricula is poorly documented. Dlouha, Mally and Dlouhy [2017] analyzed ESD principles in higher education from a perspective of Central and Eastern European (CEE) countries. They found that "opportunities for educators' competence development are lower and less diverse in the CEE region than in other parts of Europe." They claim this is due to historical reasons and the policy context, which may contribute to a delay in ESD inclusion to curricula, highlighting as the most important factor a low level of financing in this sector. Organization for Economic Co-operation and Development (OECD) shows significant underspending on tertiary education in many CEE countries both as a percentage of Gross Domestic Product (GDP) and annual expenditure per student in comparison to OECD average [Barton & Dlouhá 2014]. Latvia spent 5.34% of its GDP on education in 2015 according to UNESCO SDG database [2018]. At the same time, Ukraine spends 6 percent of GDP on education, which is one of the highest rates of public spending on education in the world [World Bank 2018]. Nevertheless, as Satu Kahkonen states in his article about the poor sustainability of Ukrainian education, "both the approaches towards teaching and towards learning are out of date... Lessons are overburdened with theoretical knowledge and lacking in practical application, while textbooks are academically dry and overburdened with secondary factual materials – dampening motivation and curiosity among students" [Kahkonen 2018].

The other common problem faced by Eastern European universities, especially in the formerly socialist states, which are at the same stage of transformation of their educational systems, is that ESD is often associated with environmental protection, ecology or environmental education and is not regarded as a "three pillar" concept with a broader sense [Barton & Dlouhá 2014].

In this paper, we try to analyze common barriers and challenges to ESD incorporation and institutionalization in universities of Central and Eastern Europe, as well as key necessities and possible solutions for the region, with a specific focus on the Ukrainian and Latvian situation. An importance of a systemic approach in ESD implementation for students – economists is also shown using the example of two highly recognized universities of Latvia and Ukraine: Riga Technical University and National University of Kyiv-Mohyla Academy.

2. Materials and methods

To analyze and extend previous empirical and conceptual research on the inclusion of ESD in higher education of CEE countries, we developed a generic matrix of options for integrating sustainability in higher education (SHE) according to the methodology proposed by Rusinko [2010]. The matrix includes four different options or scenarios for integrating ESD in universities (Fig. 1). These options are based on delivery and focus of sustainability in higher education; the matrix shows advantages and disadvantages of each option.

To compare the situation and achievements of Riga Technical University (Latvia) and National University of Kyiv-Mohyla Academy (Ukraine) with other universities in CEE countries, we have placed in the generic matrix some recent

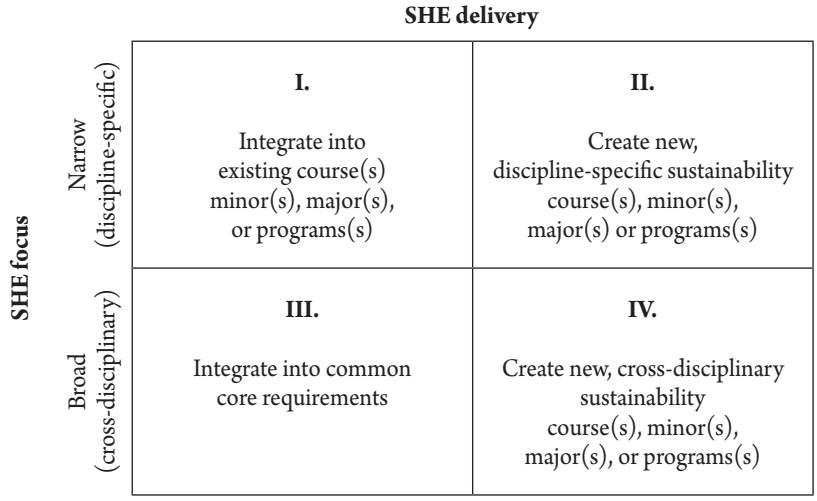

Figure 1. A generic matrix of options for integrating sustainability in higher education

Source: Rusinko 2010.

examples of ESD practices observed according to relevant literature sources [Bogoliubov 2016; Barton & Dlouhá 2014; Filho 2010; Pidlisnyuk 2010].

In order to estimate if ESD is either mentioned or incorporated into curricula and programmes of Riga Technical University and National University of Kyiv-Mohyla Academy, the strategic documents of both universities were analysed. We reviewed four open sources of information regarding each university. The documents analyzed in this paper are presented in Table 1.

Table 1. Strategic university documents for KMA and RTU

National University of Kyiv-Mohyla Academy (KMA), Ukraine	Riga Technical University (RTU), Latvia
KMA development strategy for 2015-2025	RTU Satversme
Curricula for KMA Faculty of Economy study programs	RTU strategy for 2014-2020
Curricula for KMA Faculty of Natural Sciences study programs	RTU quality policy, RTU study regulations
Official web-site with study programs description, www.ukma.edu.ua/eng	Official web-site with study programs description, www.rtu.lv/en

Source: own elaboration.

Finally, we formulated common barriers and challenges to the implementation of ESD in both universities, and tried to list and discuss possible solutions.

3. Results and discussion

3.1. Common barriers and challenges to the inclusion of ESD in CEE universities

Today education systems are currently undergoing significant changes brought about by the ongoing reform in pedagogy and technology. Many of the advances in education will be brought by further integration of personalized learning in the smart learning environment, such as ubiquitous access to technology through continuously shifting mobile devices and mobile platforms, cloud-based services, big data, and dispersed learning environments will further emphasize the advantages of learning technologies. These changes are also affected by broader trends including population shifts, economy, employment, and other societal shifts [Price 2015].

Universities can change study courses or curricula to include more information about different sustainability issues, to shift the strategic approach to edu-

cation in terms of quality, not quantity. Lecturers can also change pedagogical approaches, methods, and tools which focus less on merely providing students with ready knowledge and more on involving them in the informational flow according to ESD principles.

SHE focus \ **SHE delivery**		
Narrow (discipline-specific)	**Option I.** Integrate into existing course(s) or programs(s) Ukraine: Kyiv National University proposed a discipline Economics of Sustainable Development for the Master Programme "Environmental Business." Kyiv-Mohyla Academy has a number of specific courses related to sustainability for the Master Programme "Ecology and Environmental Protection." National Technical University of Ukraine "KPI" introduced the course "Fundamentals of sustainable development" [Bogoliubov 2016]. Latvia: Riga Technical University, Faculty of Engineering Economics and Management provide courses related to sustainability.	**Option II.** Create new, discipline-specific sustainability course(s) or programs(s) Poland: Sustainability courses are offered in Warsaw University, Adam Mickiewicz University in Poznan, Jagiellonian University in Krakow, and Wroclaw University [Barton & Dlouhá 2014]. Latvia: Riga Technical University, Institute of Energy Systems and Environment developed a course "Sustainable Regional Energy Supply" and other.
Broad (cross-disciplinary)	**Option III.** Integrate into common core requirements Poland: Technical University of Lodz has incorporated sustainability elements across its whole programme both in further education and in conventional graduate training [Filho 2010]. Slovenia: Four public universities (Ljubljana, Maribor, Primorska, and Nova Gorica) have integrated sustainability principles into their curricula [Barton & Dlouhá 2014].	**Option IV.** Create new, cross-disciplinary sustainability course(s) or programs(s) Ukraine: National Agricultural University and Kyiv National University developed a compulsory course "Environmental aspects of Sustainable Development" for all Master students [Pidlisnyuk 2010]. National University of Life and Environmental Sciences introduced the course "Strategy for the sustainable development of nature and society" for all Master students [Bogoliubov 2016]. Czech Republic: Charles University in Prague (Charles University Environment Center) established an ESD beachhead in the wider tertiary education sector [Barton & Dlouhá 2014].

Figure 1. A generic matrix of integrating sustainability in higher education in CEE universities

Source: own elaboration.

Facing the problem of SD inclusion in university strategic documents and curricula, various universities in CEE countries have already tried to integrate sustainable development in their activities in a systemic way in the last ten years. We compiled some examples of different options of sustainability incorporation in higher education in the form of a generic matrix (Fig. 2), including the cases of Ukrainian and Latvian universities.

According to Rusinko [2010], a major advantage to Option I is that "it does not require review, coordination, or support beyond that of the involved faculty member(s), and resource demands are relatively modest." In the Ukrainian and Latvian cases presented in the first quadrant of Fig. 2 we see the course proposed by faculty members for a specific Master Programme. It is easily achievable; but at the same time, the initiative is limited to the scale of a faculty or a programme.

Cases of faculties developing discipline-specific sustainability courses are presented in the second quadrant. For example, the Institute of Energy Systems and Environment of Riga Technical University developed a number of specific, but sustainability related courses, as Sustainable Regional Energy Supply, Environmental Protection and Recycling Processes, Life Cycle Analysis and other. Here learners are involved in awareness raising and real changes in consumption through the inclusion of different questions regarding chemical products used in households and their impact on the environment [Dimante et al. 2016].

The advantage of the options from the third quadrant is that "sustainability is integrated across multiple disciplines, or across the entire curriculum, and a larger number (or all students) are exposed to sustainability" [Rusinko 2010]. This is what happens in a number of Polish and Slovenian universities, which have incorporated sustainability elements across their entire programmes both in further education and in conventional graduate training, with sustainability principles integrated in their curricula [Fig. 2].

The option in the fourth quadrant requires more effort, time investment and resources. Nevertheless, it is quite popular in Ukraine nowadays to develop new cross-disciplinary sustainability courses in the leading state institutions of higher education. A comparative analysis of curricula and working programs from the ESD perspective offered by top universities in Ukraine shows that they significantly differ in structure and content due to the lack of a single standard that would reflect the composition and amount of knowledge required by professionals in this area at the Master level [Bogoliubov 2016].

Other studies also support the importance of sharing and processing experiences, mental models and interpretations concerning concepts, ideas, perspectives and new input within the group integrating ESD in higher education curricula [Cincera et al. 2018]. The study of Grienson and Munro [2018] finds that "within the sustainable education programme, both the courses and modules that have an SD focus exhibit the greatest longevity over the study period and are

selected by students significantly more often than other courses and modules." It demonstrates the programme's aspirations towards increased interdisciplinarity in postgraduate ESD.

In 2010, Walter Leal Filho tried to classify European countries according to the status of ESD and its inclusion in educational programmes, provisions for pre- and in-service education, existence of organizations that support the implementation of ESD and public awareness [Filho 2010]. Thus, in 2010, Ukraine was classified as being at Stage II (intermediary: ESD is progressively being included as part of educational programmes; training of multiplicators available but rather limited; public awareness is not often fostered). Latvia was at Stage 3 (advanced: ESD is already part of educational programmes, including pre- and in-service education, in and out of schools; there are many organisations and associations which pursue or support the implementation of ESD; public awareness is actively fostered).

It not has been changed much since 2010 for Ukraine: the regulatory framework regarding ESD has been implemented, but there are no standards or detailed provisions for further ESD implementation at the local level. The new Ukrainian law on higher education defines the principles of promoting ESD by means of lifelong learning, but again without any action planning provided to ensure the integration of ESD in institutions of higher education [Isaienko 2017].

Moreover, the analysis of government strategies and public policy on implementing the 2030 Sustainable Development Goals in Ukraine [2017] shows that SDG 4 "Quality education" has a medium level of SDG integration – 54%. The evaluation of the incorporation of the SDG targets into all Government Strategic Policy Papers across all areas was based on four criteria: (1) Availability of target implementation plan; (2) Availability of agreed target indicators and target dates; (3) Scale of the programme; (4) The extent to which the programme targets meet the SDG targets.

It is important to take this context into consideration while analyzing the ESD achievements and failures of Ukrainian universities, and Kyiv-Mohyla Academy in particular.

3.2. National University of Kyiv-Mohyla Academy analysis: basic info, history, position in Ukrainian academic field, analysis of strategic documents

National University of Kyiv-Mohyla Academy (KMA) was established in 1615, then closed, and re-opened in 1991. In XVII-XVIII centuries, KMA "considerably influenced the intellectual, scientific, educational, cultural and spiritual life of Ukraine" [Jarosewich, Farion & Khanas 2014].

In 1992 the first class of undergraduates was admitted after a second KMA establishment. In 20 years, the number of graduates rose from 151 in 1996 to more than 4,000. The university offers undergraduate, masters and doctoral programs both in English and Ukrainian. 32 departments, 22 Bachelor programs, 28 Master programs, 15 PhD programs, 8 experimental PhD programs, and 31 scientific centers meet the modern requirements to a higher education.

As stated Vyacheslav Bryukhovetsky, Honorary President of KMA, "Kyiv Mohyla Academy is guided by a vision that began 400 years ago. Petro Mohyla, our university's founder, understood that his people must adapt to a changing world, that new leaders must be educated with new methods. Four hundred years later, when Ukraine chose independence, we too needed to adapt to a changing world" [Jarosewich, Farion & Khanas 2014]. Kyiv-Mohyla Academy is among the three leading universities in Ukraine according to the Top 50 Universities by the Employers' Choice List made by the Focus Journal (focus.ua) in 2017.

Among KMA subdivision centers dealing with SD, the Center for Innovations Development (CID) should be mentioned. It was created in 2013 and has three goals: (1) Reform Support and E-Democracy development; (2) Educational Projects focusing on Theological Club and Academic E-Governance; and (3) Sustainable Technologies. Another one, Center for Ecosystem Studies, Climate Change and Sustainable Development is functioning since 2008. It deals with "research in the fields of natural and artificial ecosystems, phytocenology, plant ecology, landscape ecology, global climate change, sustainable development, as well as technical, informational and methodological support for the curriculum and for the research work of the students of BA, MA and PhD programs in ecology."[1]

As to activities related to SD, there is a number of related events. One of the most recent was held on December, 7th 2017: the conference "The role of education in implementation of the Sustainable Development Goals (SDGs) till 2030 in Ukraine." The conference was held in partnership with the UNDP Office in Ukraine, and KMA was represented by the Department of Ecology. One of the main topics of the conference was the analysis of the best practices for integrating the paradigm of the Sustainable Development Goals into educational programs. It has been indicated that Kyiv-Mohyla Academy is a part of this process.

To look more broadly, KMA development strategy for 2015-2025 indicates the main strategic goals of university in five domains: education, science, international cooperation, administration, and finances. Under its vision, KMA is a leader in innovations and actively influences the future of Ukrainian society combines scientific activity, educational process and acquisition of practical skills, and is a prestigious, internationally recognized academic community, research univer-

[1] Official KMA web-site: www.ukma.edu.ua/eng/index.php/research/centres/centre-for-studies-of-ecosystems-climate-change-and-sustainable-development.

sity. Values strategically supported in KMA community include Personality; Humanism; Creativity - Liberal Arts; Leadership; Quality; National consciousness; Democracy; and Active civic position [KMA strategy 2015].

Despite the fact that the strategy of KMA is a profound and progressive document, it does not have any ESD components and does not even mention the concept of sustainability. The faculties act without a synergetic collaboration, strictly within their specializations. In KMA there is no SD department or coordination unit; the SD concept is mostly familiar to students of the Faculty of Natural Sciences, but not to Law and Economy students, who can be regarded as future "agents of change" for the Ukrainian society. The level of educational quality and innovativeness varies between different faculties with no systemic / complex vision of the ecological and economical systems in a one picture.

3.3. Riga Technical University analysis: basic info, history, position in Latvian academic field, analysis of strategic documents

Riga Technical University (RTU) is the leading technical higher education and science institution in Latvia. It is international, highly recognized university and the biggest one in Latvia. There are almost 15 thousand students in all levels of education.

RTU was founded on October 14, 1862 and is the first higher education institution in Latvia. At first it was founded as Riga Polytechnic and later became Riga Polytechnic Institute. In the middle of the 19th century Riga Polytechnicum was closely linked to economic and political changes in Europe. His current name - Riga Technical University - was awarded on March 19, 1990. Since then, the higher education institution has been reorganizing the study process, ensuring academic and higher professional education in the sectors characteristic of the national economy of Latvia [RTU history 2018].

The goal of RTU is to become a third generation university. The values of Riga Technical University are quality, academic freedom, sustainable development, honesty, cooperation and stability. RTU has nine faculties, including 33 institutes. Students in engineering and in social sciences and humanities receive high quality education, can do research and practically implement scientific discoveries. All RTU study programs are officially accredited and highly evaluated by students, business society and international experts [RTU 2018]. The Satversme is the basic law of the University (RTU Satversme 2014) and University carries out its activities on the basis of the Satversme.

RTU also has own strategy for 2014-2020. The vision of Riga Technical University is to "become the leading science and innovation university in the Bal-

tic States by 2020." To implement this setting, "the RTU strategy defines three university goals – a qualitative study process, excellent research, as well as sustainable innovation and commercialization activities." For these three purposes, specific performance indicators have been defined that will enable the RTU to implement its vision by 2020 (RTU strategy for 2014-2020). Five main priorities of the University have been defined: internationalization, interdisciplinarity, organizational, financial, and infrastructure efficiency (Fig. 3).

Figure 3. RTU strategy elements

Source: RTU strategy for 2014-2020, 2018.

RTU has quality department and quality policy. The university's quality policy is aligned with the standards and guidelines of the European Association for Quality Assurance in Higher Education (ENQA) and the standard ISO 9001: 2015 (RTU quality policy 2017). The Quality Policy of the RTU focuses on the implementation of the RTU mission and the achievement of strategic objectives – the achievement of scientific activities, studies, infrastructure, organization excellence and visibility.

In its work, RTU takes into account United Nations 17 Sustainable Development Goals (SGD) with the most important proclaimed as following (RTU goals 2018):

– Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all;

– Goal 6. Ensure availability and sustainable management of water and sanitation for all;

– Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all;

– Goal 9. Build a sustainable infrastructure, promote inclusive and sustainable industrialization and foster innovation;
– Goal 12. Ensure sustainable consumption and production patterns;
– Goal 17. Revitalize the global partnership for sustainable development.

Many study programs in RTU include different study courses connected with sustainable development issues. The most "environmental oriented" is RTU Institute of Energy Systems and Environment (IESE). Now it provides Bachelor, Master and Doctoral program of Environmental Science. It also provides "material, technical and scientific basis for the development of Latvian science in the fields of energy and environmental sciences, carrying out scientific research, development of products and services with high added value with purpose to use them for the national economy and also approbate their commercialization on the market of innovative technologies" (RTU IESE 2018).

The IESE provides a number of the study courses related to sustainability: Sustainable Development of Energy Supply, Sustainable Regional Energy Supply, Environmental Protection and Recycling Processes, Life Cycle Analysis, Eco-management, Eco-design etc.

Other faculties programs do not include many courses connected with sustainable development and mostly cover specific topics of study programme. On the other hand, different study programs in Faculty of Engineering Economics and Management provide courses related to sustainability in a broad sense, such as Sustainable Economic Development, Management of Ecological Systems, Management of Ecology, Energy Efficiency in House and Building Management, Corporate Social Responsibility etc.

All of the above show that RTU is on a positive development vector and has a good basis for further development of ESD at the university.

3.4. Analysis and recommendations for KMA and RTU

In general, many separate questions and topics connected to SD have been included in study programs and courses in RTU and KMA recently. During the common discussions with the administrative staff of both universities, some common barriers to enhancing ESD were indicated:

– low transparency and participatory levels of the decision-making process of university administration;
– inefficient communication of university principles to staff and students;
– lack of communication between teachers of different departments and faculties;

– competitive rather than cooperative character of the relationship between departments and faculties.

One of the possible solutions in ESD enhancement could be to develop a course covering different SD questions for Bachelor study programs at the Faculty of Engineering Economics and Management of RTU or the Faculty of Economics of KMA, to enhance a systemic approach and broader vision of future economists. For that, a number of specific steps need to be taken, such as an audit of existing courses at each faculty, curricula improvement or development of a new course on SD covering different SD questions for Bachelor study programs at each Faculty. Also some project based learning should be introduced in order to improve teaching tools and materials, with real-life problem-based cases to be used together with cross and multi-disciplinary cases. It will help to improve curricula and to include modern and necessary topic in the study program, as a result to have more competitive study programs.

As regards a new study course on SD for KMA economists, it will mean an incorporation of components of disciplines of Ecology Department: Ecological Economics, Management of Natural Resources, Principles and Concepts of Sustainable Development, as well as a cooperation with Kyiv-Mohyla Business-School and Faculty of Economics. Like in the case of RTU, a number of steps are necessary:

– analysis of strategic documents and educational programs of Faculty of Economics of NaUKMA;

– screening and identifying of the ESD component;

– individual meetings with administration;

– cross-departmental meetings (Faculties of Natural Sciences and of Economics) on ESD issues;

– development of a facultative study course program and its inclusion in the curricula.

In order to make the discussion more practical, we formulated a list of suggestions on current teaching and learning transformation in order to respond to sustainability challenges. Firstly, it is necessity to shift from fixed knowledge to flexible components, which can be modified and updated easily in order to face the rapidly changing informational environment, in university studies. More attention should be paid to providing tools and instruments rather than ready solutions for students, who potentially can be regarded as future decision-makers for our society. In addition, modern pedagogical skills should be introduced by involving more interactive and practically oriented methods of education, like simulation games, debates, and case studies. Key competencies for sustainability should be actively promoted for university integration, which include systems and critical thinking, collaboration, self-awareness, integrated problem-solving, as well as anticipatory, normative, and strategic competencies (according to

UNESCO Education for Sustainable Development Goals: Learning Objectives, 2017). Thus, key necessities and possible solutions for the incorporation of ESD in the university strategic activities include:

– re-analysis and regarding academic institutions as at complex systems working with or without a ESD context;

– a dialogue with a "new ESD language" with our colleagues;

– more collaboration and a broader vision to ensure ESD principles in a university work;

– a "teachers sharing" practice across different departments / faculties;

– renewed strategic documents of the university in a participatory and transparent way.

4. Conclusions

The above analysis of some examples of integrating sustainability in higher education in universities from Poland, Slovenia, Czech Republic, Ukraine, and Latvia shows different ways in which ESD is implemented in the CEE region, both across disciplines and discipline-specific applications. ESD delivery is being realized both in the form of its integration into existing courses/programs or university common core requirements and development new sustainability courses/programs.

The barriers to ESD incorporation for both Kyiv-Mohyla Academy and Riga Technical University are faced by many universities in the CEE region. In the period of the educational reform in an Eastern European country like Ukraine, ESD is often associated with ecology or environmental education; sustainability courses focus mostly on ecological problems. Also owing to the lack of resources and proper understanding, ESD is often not prioritized at the level of strategic development of the university and is presented in the form of separate study courses. Here a range of the internal communicational problems between administration and faculties occur on ESD importance for its inclusion in curricula. As a result, a multidisciplinarity of the topic presented in many non-harmonized disciplines of different faculties leads to the overlapping of the study course content. This conclusion can be supported by other estimations of Ukraine being at the intermediary stage, when ESD is progressively being included as part of educational programmes and public awareness is not often fostered.

Among possible ways of more effective ESD presence in higher education in CEE region, we can mention a necessity to re-analyze and regard academic institutions as at complex systems working with an ESD context. A dialogue with a "new ESD language" should be established, bringing more collaboration

and a broader vision to ensure ESD principles in the work of the university. The idea of "teachers sharing" (an internal guest lecturing) practice across different departments / faculties within a university could eliminate communication and information exchange problems. Key competencies for sustainability should be actively promoted for university integration, which include systems and critical thinking, collaboration, self-awareness, integrated problem-solving, as well as anticipatory, normative, and strategic competencies.

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Wdrażanie edukacji na rzecz zrównoważonego rozwoju na uniwersytetach Europy Środkowej i Wschodniej: bariery, wyzwania i rozwiązania dla Kijowa i Rygi

Streszczenie. Artykuł stanowi przegląd ewolucji koncepcji edukacji na rzecz zrównoważonego rozwoju oraz barier napotykanych podczas jej wdrażania na uniwersytetach Europy Środkowej i Wschodniej, ze szczególnym naciskiem na wyzwania związane z instytucjonalny włączaniem

zasad edukacji na rzecz zrównoważonego rozwoju na dwóch wiodących uczelniach: Ryskim Uniwersytecie Technicznym na Litwie oraz Narodowym Uniwersytecie Akademii Kijowsko-Mohylańskiej na Ukrainie. Autorzy przedstawiają zestaw możliwości integracji zasad zrównoważonego rozwoju w szkolnictwie wyższym w celu przeanalizowania i rozszerzenia zakresu dotychczasowych badań prowadzonych w tej dziedzinie w krajach Europy Środkowej i Wschodniej. Ponadto wskazują wiele wspólnych barier i możliwe sposoby ich pokonywania w celu skutecznego wdrażania zasad edukacji na rzecz zrównoważonego rozwoju w programach nauczania.

Słowa kluczowe: edukacja na rzecz zrównoważonego rozwoju, Europa Środkowa i Wschodnia, bariery edukacyjne, cele zrównoważonego rozwoju

Studia Periegetica nr 3(23)/2018
DOI: 10.26349/st.per.0023.07

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Heuristic Method for Successful Learning in Education for Sustainable Development

Summary. The economic and social transformations that have taken place in the Republic of Belarus in recent decades have led to a change in the state educational paradigm towards the priority of personal development and self-realization of students. The transition to new socio-economic relations emphasizes the task of developing abilities to overcome emerging problems, to offer non-standard solutions. There is an urgent need to develop creative abilities of the future specialist. The problem of freedom of choice and the possibility of making independent decisions in conditions of social change are becoming significant. In this regard, innovations in the educational activities of the Yanka Kupala State University of Grodno are aimed at changing the personal attitude, the implementation of decisions, and the position of responsible and independent decision-making of future specialists. One of the methods that ensures the activity of students in the process of employment, as well as their independent thinking, is the heuristic method of teaching.

Keywords: heuristic, heuristic dialogue, communicative competence, Education for Sustainable Development (ESD)

1. Introduction

Indeed, education is one of the world's most important human rights. But education is a prerequisite for achieving sustainable development and an essential tool for good governance, informed decision-making and the promotion of democra-

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cy also. Today it is recognized that the education system needs to be strengthened by sustainable development. This can be done by including a holistic approach in the educational curriculum from primary school right up to universities and graduate schools. Education for Sustainable Development can provide critical reflection and greater awareness and empowerment so that new visions and concepts can be explored and new methods and tools developed.

The task of modern education is the formation of the student's autonomy, his creativity, which guarantees the personality the possibility of self-education, intercultural interaction, and the development of professional competence. Also one of the most important tasks of education is to develop creativity, critical thinking, and an ability to communicate and cooperate.

Today, the strategy of sustainable innovation development of the world community demands not only the creation of favorable social and economic conditions, but also specific measures to form a new world outlook. For example, bringing up people who are able to perceive the present through the comprehension of the unity of the world and nature. With the global ecological crisis become increasingly serious, mankind has to admit its guilt on the one hand and on the other hand, has to look for a way to overcome it. It is clear that the system of ecological knowledge and behavior should reach, first of all, those who are responsible for the education of the future society, teachers.

Major changes have taken place in higher education in the Republic of Belarus recently. They are associated with the following trends: globalization of the educational space, change of the educational paradigm, Belarus joining the Bologna Process, large-scale introduction of information and communication technologies in the educational process of universities.

UNECE Strategy for education for sustainable development [2005] states that [article 41] "for ESD to become part of an agenda for change towards a more sustainable society, education itself must be subject to change. Research that might contribute to ESD should be encouraged. There is a need for increased cooperation and partnerships between stakeholders in research and development activities, ranging from identifying issues to working with new knowledge and making it known and used. The results of research and development efforts should be shared with actors locally, regionally and globally, and be incorporated into different parts of the education system, experience and practice."

2. Significance of teaching methods

Interest in strategies of learning has been renewed nowadays for several reasons. For example, society gives priority to students and directs strategies of teaching

and learning towards the development of his or her autonomy. This fundamental right of the student requires acquisition of cognitive methods and of methods of self-assessment, self-reflection and self-organization [Ellis & Sinclair 1989].

The analysis of theoretical literature has allowed us to conclude that the problem of the development of such a quality of personality of students of a pedagogical university has not been sufficiently studied. This makes it difficult to improve the development of this competence among students of a pedagogical university. Analysis of regulatory documents curricula, real educational practice in a pedagogical university, as well as a survey of students showed that the existing professional training of the future teacher is not sufficiently focused on the implementation the strategy of sustainable development. Above mentioned allowed us to say, that the process of teacher preparing should be aimed primarily at the development of their personal qualities. In this case, gaining knowledge by transferring the accumulated experience cannot be the purpose of learning.

3. Successful learning for sustainable development

Educational and creative potential of young teachers in different countries of the world is formed under the influence of both the state and national traditions as well as through world integration and strategy of cooperation. A retrospective view of the history of the question reveals that a society realized the necessity to preserve the environment for life when a destruction of the biosphere by humans began to directly threaten the existence of the civilization. At the same time scientific understanding of the ties and unity of the biosphere does not mean a momentary change of the human consciousness with reference to the management of nature. Education for sustainable development involves knowledge, values and action competence. Students develop the capacity to act when they work with real and meaningful issues where they experience their work leading to change. The goal must be for students to acquire both the ability and the desire to act for sustainable development.

Education is one of the basic human right. Otherwise, as emphasize the Authors of Mediterranean Strategy on Education for Sustainable Development [2014] "is a prerequisite for achieving sustainable development and an essential tool for good governance, informed decision-making and the promotion of democracy." They indicate that education for sustainable development:

– strengthens the capacity of individuals, groups, communities, organizations and countries to make judgments and choices in favor of sustainable development;

– can promote a shift in people's mindsets and in so doing enable them to make our world better, safer, healthier, with more possibilities for employment and more prosperous, thereby improving the quality of life and equity among countries and generations;

– can provide critical reflection and greater awareness and empowerment so that new visions and concepts can be explored, and new methods and tools developed.

The potential of heuristic pedagogy as a strategy of education for sustainable development is very important. It is showed that modern social-cultural dynamics needs personalities with advanced level of internal mobility, flexibility and skills of self-transformation according to changeable social environment. It is demonstrated that heuristic pedagogy is focused on personality development of student [Arechavaleta & Navarro 2010: 351-364].

The study at university loses its meaning without active substantial communication with representatives of another academic environment and culture as a whole. Having no substantial communication, students do not change their knowledge, skills, competencies and the heuristic potential of personality doesn't increase. Also this strategy can organize qualitative interaction with another culture and develop students' world-views.

We want to review the principals underlying the construction of different types of models of teaching at the university using the method of heuristic dialogue and to show its role by applying it to the idea of sustainable development.

Heuristic learning is explained as learning, which aims to design students' own sense, goals and content of education, as well as the process of its organization, diagnosis and awareness. The method of heuristic learning has its own characteristics. In heuristic learning, educational material plays a very important role. It is used to create a student's own educational content in the form of his personal creativity products.

3.1. The school of heuristic dialogue in education

The most important element of heuristic education is the principle of personal goal-setting. Goal-setting takes place in the heuristic training through the whole process of education. It motivates the activities of students, structuring their learning process, allows you to clearly diagnose learning outcomes [Korol 2017: 88].

"Mastering the alien external and »correct« information does not change the person, and allows you to see the world through the eyes of a stranger. Monologist education system produces a Monologist Apprentice, seems to be a factory of stereotypes of thinking, communication, behavior" [Korol 2013b: 158].

"Socratic Dialogue is an ancient technique of engaging a student in a dialogue by asking non-leading questions, aimed at revealing to the student how much knowledge he or she already has on some topic. It derives its name from Socrates, Plato's teacher. His idea behind this was that one does not gain understanding by getting it 'dished up', but only by thinking for oneself" [Kessels 2009: 36]. It is important to note that Socratic Method's focuses on a combination of collective and individual learning.

"The Socratic dialogue is an attempt to come to a common answer through systematic deliberation about a fundamental question. It is not about merely theoretical questions. Rather it is about questions which derive from concrete experiences, accessible to all participants. The conversation in fact is a systematic reflection upon experiences. He tried to bring people to a deeper understanding by asking questions, by inquiring about examples and analyzing experiences" [Korol 2013a: 11].

"But in order to gain genuine knowledge certain abilities are required:

– The learner must be willing to be actively involved in the experience (sharing of one's story);

– The learner must be able to reflect on the experience (reflecting on the question at hand);

– The learner must possess and use analytical skills to conceptualize the experience (engaging in dialogue and good conversation or »philosophizing«);

– The learner must possess decision-making and problem solving skills in order to use the new ideas gained from the experience (developing a better understanding of how to voice one's moral concerns or confront moral muteness)" [Sims 2004].

We outline the Socratic Dialogue as a method of both researching and teaching creative thinking, and we reveal that the Socratic Method dovetails with this conception of co-creativity.

Kondrateva et al. [2016] formulated a hypothesis that "the effectiveness of the student as a person of culture in a multicultural education in non-language high school increases significantly under the following pedagogical conditions:

– the creation of a multicultural educational environment that encourages the development of various aspects of the personality of the student as a man of culture and contributing to the formation of his main qualities (humanism, tolerance, sociability);

– systematic, gradual mastery of the student's human values and moral qualities;

– organization of multicultural educational activities of students, aimed at overcoming all sorts of barriers to their development as human beings of culture by creating an atmosphere of creativity, implementation of complex training and educational tasks of multicultural orientation;

– accounting the laws of bilingualism;

– organization of training taking into account the principles of student-centered learning and the principles of the method of heuristic dialogue" [Kondrateva et al. 2016: 60].

"The recognition of the uniqueness of the individual and self-worth of each student resembles an original man who has his own predestined and genetically founded »program« of education, realized in the form of its individual trajectory in relation to general education. This postulate reflects one of the oldest ideas of human culture – everyone has their predestination and their mission" [Korol 2016: 159].

3.2. How to teach all students in different ways but similarly

Yanka Kupala State University of Grodno is the largest regional university in the Republic of Belarus. It is a center for scientific and innovation development of the Grodno region.

For more than 20 years Yanka Kupala State University of Grodno is actively involved in managing of international projects, has vast experience working within Tempus, Erasmus Mundus, EU Cross-Border Cooperation programs, etc.

YKSUG is a full member of the Baltic Sea Region University Network Partnership (BSRUN), European University Association (EAU), Eurasian Association of Universities (EAU), Baltic University Programme (BUP).

Yanka Kupala State University of Grodno carries out research activity such as: internationalization of higher education, Sustainable Development, ecology tourism, innovative activity, cultural and historical heritage, transport and logistics, etc.

The process of the evolution of higher education for sustainable development (ESD) in the Republic of Belarus is still ongoing. And Yanka Kupala State University of Grodno, like many other universities in Belarus, has made a commitment to include ESD in its post-2014 development agenda, after a decade of ESD implementation in Belarusian universities.

We will try to identify significant achievements, and the best ESD practices in the university.

According to UNESCO among the goals of Education for Sustainable Development are the following:

– to use the creative potential of the scientists and the teachers more efficiently;

– to work out and implement the educational programmes of retraining and professional upgrading for people working in educational institutions of different levels as well as programmes for social workers;

– to develop international partnership for consolidation of interaction and cooperation for sustainable development through common projects;

– to organize teaching staff exchange and student mobility (Khanty-Mansiysk, Russia, 2009).

"The National Strategy for Sustainable Socio-Economic Development of the Republic of Belarus by 2030 emphasizes the importance of sustainable development in educational processes. To secure the sustainable development in education, its principles need to be implemented in all training courses. Higher pedagogical education should provide training in designing and teaching such courses" [Gadzaova, Murauyova & Urban 2017: 75]. The main question is "What kind of pedagogical conditions are necessary for the development of the competence of students for sustainable development using the method of heuristic dialogue?" To find the answer we have analyzed the National Strategy and fixed out two important factors:

1. The availability of teaching staff to take part in this process and their ability:

– to use new educational technologies;

– to take part in cultural, social and educational activity of the University;

– to take part in the international project activity;

– to lead healthy lifestyle;

– to promote nature protection, love to home town, country etc.;

– to facilitate and encourage public awareness by making environmental information widely available.

2. To fulfill the goals of Education for Sustainable Development we need the second factor – students

– students must be ready not only to get knowledge, but to have active living position to achieve SD;

– together with the students and teachers education sector is a powerful force, a communication channel for disseminating knowledge and skills;

– educational institutions should incorporate the concepts of sustainability in all academic disciplines and should take the leadership for establishing a network with primary and secondary education [National Strategy... 2015].

At our university, training future school teachers to build their lessons in line with the principles of sustainable development covers three key areas. The first area relates to the development of pupils' social involvement through acquiring intellectual and practical skills. The second area concerns pupils' relationship with their natural and cultural environment. Future teachers are trained to design the lessons stimulating pupils' emotional engagement and caring attitude. The third area that future teaches are trained to target is pupils' economic and financial competence.

We recognize that he education system of the Grodno region needs to be strengthened by sustainable development. This can be done by the inclusion of

a holistic approach in the educational curriculum from primary school right up to universities and graduate schools. Education for Sustainable Development can provide critical reflection and greater awareness and empowerment so that new visions and concepts can be explored and new methods and tools developed.

This heuristic effective teaching is fundamental to all aspects of planning learning experiences and the practices of teaching. It is also the area in which much creativity can be generated and applied as it offers almost limitless possibilities in terms of how teachers can maximize attention and variation in the learning process.

The main components of heuristic education through dialogue focus on solving one of the fundamental problems of education today: how to overcome its monologue (reproduction) focus on the transfer of the student so-called "ready" knowledge. Innovative didactic training systems help to overcome the monologue of the existing education and ensure the transition to a qualitatively new level of student training.

The author of the system of heuristic learning based on dialogue is Andrei Karol, Rector of BSU, Doctor of Education, Professor. The author, based on his own fundamental methodological and theoretical quest over many years of testing in the educational process of school and higher education system, offers an original system and technology of heuristic learning through dialogue. The heuristic dialogue describes a situation where students pose questions at all stages of the educational activities (goal-setting, choice of means and methods, implementation of the objectives of reflection). Students' questions are the key methodological, methodical component and system simulation tool of heuristic learning through dialogue. The author also offers the methodology of interactive educational activity of the student, which finds its expression in three groups of methodological cognition of the objects ("What?," "How?," "Why?"). Interactive components of heuristic education model forms the basis for the interaction of personal and public education components. The author offers internal and external components of the heuristic-interactive tasks for the students.

4. Conclusion

Yanka Kupala State University of Grodno is the largest regional university in the Republic of Belarus. It is a center for scientific and innovation development of the Grodno region. The region is an exceptional eco-region because of its geographical and historical characteristics, its unique natural and cultural heritage. At the crossroads of three borders the region brings together countries and peoples of different levels of economic and social development, different religions, languages and cultures, that share, however, a common heritage, created throughout

centuries old 'exchanges' of all kinds. Given these characteristics, the Grodno region is a perfect illustration of the global situation.

Yanka Kupala State University of Grodno has a strong focus on sustainability in its research. The University is also working on pushing the sustainability agenda within teaching and learning. One of our strategic priorities is to explore ways in which we can embed sustainability into the academic curriculum and the experience of all our students. We have a three-pronged approach to this:

– using sustainable learning technology;
– developing discipline-related content about sustainability;
– developing and supporting sustainable methods of teaching and learning to develop sustainability literacy.

The Socratic method is one of the best ways to help guide the students through critical thinking in a way that is challenging and engaging.

Socratic dialogue, in our view, is a form of experiential learning and provides students with the opportunity of "learning by doing." The Socratic method design engages students in a dialogue in which they play an active role by sharing their stories and experiences and then reflecting about them, for example regarding voicing or not voicing their concerns.

The Socratic Method design proposed in this paper, like experiential learning, is effective as it involves students' reflecting on and sharing past and current experiences and making observations. Thus, our premise that Socratic Method provides a way for experiential learning to be incorporated in the process of learning in teaching efforts or "learning by doing."

It should be emphasized that, of course, heuristic learning cannot completely replace traditional learning, but it is advisable to use it as an organic complement to traditional learning technologies at the university.

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Heurystyczna metoda jako wsparcie skutecznego uczenia się w ramach edukacji na rzecz zrównoważonego rozwoju

Streszczenie. Przemiany gospodarcze i społeczne, jakie nastąpiły na Białorusi w ciągu ostatnich dziesięcioleci, doprowadziły do zmiany państwowego paradygmatu w edukacji, która polega na wzmocnieniu roli rozwoju osobistego i samorealizacji studentów. Przejście do nowych stosunków społeczno-ekonomicznych wiąże się z koniecznością rozwoju umiejętności przezwyciężania pojawiających się problemów i poszukiwania niestandardowych rozwiązań. Pojawia się zatem potrzeba rozwijania zdolności twórczych przyszłych specjalistów. Coraz większego znaczenia nabiera problem wolności wyboru i możliwość podejmowania samodzielnych decyzji w warunkach zachodzących zmian społecznych. W związku z tym innowacje w działalności edukacyjnej Grodzieńskiego Uniwersytetu Państwowego im. Janki Kupały mają na celu zmianę osobistej postawy, kształcenie umiejętności odpowiedzialnego i niezależnego podejmowania decyzji przez przyszłych specjalistów. Jedną z metod zwiększających aktywność studentów w procesie edukacji i prowadzących do niezależności intelektualnej jest heurystyczna metoda nauczania.

Słowa kluczowe: heurystyka, dialog heurystyczny, kompetencja komunikacyjna, edukacja na rzecz zrównoważonego rozwoju

The WSB University Press Instructions for Authors Submitting Their Contributions in English

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- author's first and last name, ORCID number, academic degree/title
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- numbers consisting of up to 4 digits: use no thousands separator (5000 rather than 5,000 or 5 000); numbers composed of 5 or more digits – insert space every three digits starting from right (5 000 000 rather than 5,000,000)
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  Lane W.R., King K.W., Reichert T., 2011, *Kleppner's Advertising Procedure*, Upper Saddle River, NJ: Prentice Hall.
- **chapters in edited books –** last name and first name initial of chapter author, publication year, title of chapter [not italicized], in: first name initial(s) and last name(s) of editor(s) (ed. or eds.), *title of edited book* [*italicized*], place of publication [colon], publisher, page range:
  Cornwall W., 1991, The Rise and Fall of Productivity Growth, in: J. Cornwall (ed.), *The Capitalist Economies: Prospects for the 1990s*, Cheltenham, UK: Edward Elgar, 40-62.
- **legislation**
  Council Directive 90/365/EEC of 28 June 1990 on the right of residence for employees and self-employed persons who have ceased their occupational activity.
  Act of 4 February 1994 on Copyright and Related Rights, Journal of Laws No. 24, item 83, as later amended.
- **studies and reports**
  World Energy Council, 2013, *World Energy Resources: 2013 Survey*, London.
- **online sources** [in square brackets, indicate when website was last accessed]
  www.manpowergroup.com [accessed May 28, 2015]

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  Michalewicz A., 2001, Systemy informacyjne wspomagające logistykę dystrybucji, w: K. Rutkowski (red.), *Logistyka dystrybucji*, Warszawa: Difin, 102-123.
- **akt prawny**
  Ustawa z dnia 8 marca 1990 r. o samorządzie gminnym, t.j. Dz.U. 2001, nr 142, poz. 1591.
  Ustawa z dnia 19 listopada 1999 r. Prawo działalności gospodarczej, Dz.U. nr 101, poz. 1178 z późn. zm.
  Dyrektywa Rady 2004/67/WE z dnia 26 kwietnia 2004 r. dotycząca środków zapewniających bezpieczeństwo dostaw gazu ziemnego, Dz. Urz. UE L 127 z 29.04.2004.
- **raporty, analizy**
  GUS, 2015, *Pomorskie w liczbach 2014*, Gdańsk.
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