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V-STRENGTH

International virtual conference on green jobs and work related competences in chemical engineering

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Preface

International virtual conference on green jobs and work related competences in chemical engineering: V-STRENGTH

The International V-STRENGTH Conference on green jobs and work related competences in chemical engineering was held on 27-30 September 2015 in Spain, Bulgaria, United Kingdom and Slovenia organized by the STRENGTH Consortium partners. The members of Conference committee were: prof. Nikolay Vassilev, Spain, prof. Anna Kujumdzieva, Bulgaria, prof. Stanislav Avsec, Slovenia, Ph.D. Branko Kaučič, Slovenia, and M.Sc. Maja Ramšak, Slovenia.

The main aim of the conference was to promote international collaboration and cooperation among scientists from different disciplines involved in green jobs, education, and chemical engineering. The overall objective of the conference was to produce an integrated approach that addresses and proposes solutions to needs of competency-based economy and to boost green pedagogy.

A number of scientists and scholars attended the virtual conference, reported by IP records from different countries. The theme of the conference was "Green sustainability". The 17 contributed papers, 16 presentations were presented via V-STRENGTH platform in the following topical sessions:

1. Project STRENGTH results and perspectives
2. Green jobs
3. Green areas

A newly developed STRENGTH competence model with a competency-based approach and taxonomy of knowledge, skills and wider competences is introduced and discussed for the general application scenarios and for the specific use cases in vocational education and training for Chemical engineering sector. It was shown that competence modelling and the presented competence model lead to an improvement of the green jobs, of the organizational and individual development, to an increase of the mobility worldwide as well as to a higher transparency and recognition of competences and skills. Finally, leading initiatives in green pedagogy using competency-based instructions of different levels of education and training were introduced and the current exemplary case studies were highlighted.

Finally, we would like to thank all the participants of the Conference. It was the quality of their presentations and their contributions that made the Conference a scientific success. On behalf of the V-STRENGTH Conference organizers and attendees, we hope that you enjoy reflecting and discussing the proceedings with your colleagues.

Editors
Stanislav Avsec
Branko Kaučič

STRENGTH

2013-1-ES1-LEO05-66726

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Structuring of Work Related Competences in Chemical Engineering - STRENGTH: An Overview

Abstract

This paper will summarize project STRENGTH results, use cases, and impacts of green competences and skills in the area of Chemical Engineering. It will highlight: (1) the role and benefit of green jobs needs analysis, (2) web platform development and operation for green competency acquiring, (3) development of green competence matrix, (4) mobility scheme to enhance interoperability of human cognitive resources at global labour market (5) approbation and validation / evaluation of project deliverables, (6) Strength project management guide, (7) Quality management, monitoring and evaluation manual, and (8) Dissemination strategy and tools used to communicate the STRENGTH project's results. In this regard, the main characteristics of this innovative approach called green competency modelling and profiling and its relevance in vocational education and training (VET) for green jobs can only be summarized. A focus on jobs is no longer enough. Human resource practitioners need to explore this new approach as a foundation for their work, an approach called competency-based structuring of work related competences for competitive green jobs.

Keywords: Chemical engineering, green jobs, competency-based approach, green mobility, quality and competitiveness

Introduction

The STRENGTH project aims at introducing a synergic transfer of an existing model training system (Vocational Qualification Transfer System in Public Health) for workplace basic skills development within the Chemical Engineering field keeping green abilities awareness in STRENGTH partners' countries, regarding the shift of the European labour market towards knowledge-based economy and sustainability of jobs. STRENGTH consortium is structured on the basis of complementing background, professional expertise and experience of the partners. It includes five partners from four EU member states - Spain (P0: University of Granada - promoter), Bulgaria (P1: Intellect Foundation, Sofia; P2: Scientific Research Department of the Sofia University "St. Kliment Ohridski"), Slovenia (P3: University of Ljubljana), United Kingdom (P4: LKF

Associates Ltd.), and comprises 2 Universities (P0, P3), R & D Centre (P2), NGO (P1), and SME (P4). The project consortium consists of members with wide experience in different national / EU initiatives. They can integrate innovative practices into educational system and provide the necessary policy background for realization of project aims. The "transfer of innovation" process will be supported by associate group of silent partners.

The STRENGTH project provides strategic advice on formulation of a green economy strategy, engaging global best practices and making connections to global network of green economy lessons learned. It analyses the global trends in green economy with focus on clean technology investments and fiscal instruments to generate efficient use of energy, water, mining, building, transport, and wastes.

The project objectives are focused on introduction of the "green abilities" concept to create new opportunities of vocational education and training (VET) teachers and systems to build up green employability skills and further ecological awareness development in job seekers. In this way participants in VET will acquire knowledge for new generic employability and green skills for performance of personal development, employability and introduction in the European labour market. The project objectives comprise development of a Competence Matrix, upgraded as an intelligent tool for competence description and creation of new content in Chemical Engineering in respect to:

- review of national / EU competences in project field, mapping benchmark descriptions in relation to the intelligent tool and generation of personalized records;
- transfer a mobility procedure within the frame of Chemical Engineering at EU level;
- testing / evaluation of STRENGTH intelligent tool for transparency of qualifications;
- building up a canvassing partnership with sectoral organizations for embedding the new model;
- implementing different national / EU initiatives;
- integrating innovative practices into the educational system and providing the necessary policy background for realisation of the project's aims. The "transfer

of innovation" process will be supported also by an associate group of silent partners.

The central point of the Project STRENGTH is to develop a Qualification Record based on competences related to green abilities that a chemical engineer could additionally acquire and, in addition, a Mobility Scheme that reflects the vision of the STRENGTH Consortium on the transnational VET mobility aimed at international recognition and validation of competences and qualifications. The description of the competences on the various steps of competence development takes place in a context - related manner. STRENGTH model core work tasks are comprehensive tasks within the green jobs context a person with the respective occupational profile has to deal with. Thus, the descriptions of the competences are designed to form a clear picture of how they can be applied in the green jobs context. The descriptions include green jobs-related categories to clarify the work activities in the Chemical Engineering field. It is important to note that while the common competences describe what a trainee, completed a full training programme in Chemical Engineering area should be able to do, the green competences specify the knowledge and skills trainees in a defined Chemical Engineering area should have in green jobs related context. Both types of competences are successfully covered through the accomplishment of specific study courses. Each competence is linked to the specific learning objectives of the relevant study courses. As the Chemical Engineering specific competencies are interdisciplinary by nature, for many of them one and the same specific course is required to be covered. The Project also includes a Competence Profiler unit. Being formed from defined parts of a Competence Matrix, the competence profiles generally cover certain part of all competences described in the Competence Matrix. The organizational profile is formed by identifying competences relevant for the corresponding qualification. It is foreseen to be in compliance with the requirements of the authorities responsible for the respective qualification. The individual profiles reflect the competences that can be acquired by an individual in training.

The STRENGTH Project members do hope to provoke interest in the National and European authorities, students, professional organizations, and enterprises in order to make more attractive and greener the Chemical Engineering education and work.

Present status and challenges of the LdV "STRENGTH" project: Why "STRENGTH"?

Nikolay Vassilev and Maria Vassileva, University of Granada, Spain

The EU education policy was reinforced by linking up education and training with labour market needs. The recent trends in this field are reflected in the European Policy Agenda, and are connected to the need for development of knowledge-based economy. Among the important factors influencing this policy are: i) ageing of the population; ii) increasing demand for lifelong learning opportunities iii) shift of the system from "knowledge" to "competence" and from "teaching" to "learning". These changes have stimulated the demand for workers' knowledge and skills upgrade. As a part of the project STRENGTH, a deep analysis of the current status and of a set of National Reports elaborated by all participating countries has been carried out to determine the need of green jobs and related green skills, and restructuring of competences, particularly in the field of Chemical Engineering. All this information was analysed bearing in mind the interrelation between Industry and Education.

The European Union green good and services sector more than doubled in size in the last decade, according to latest figures released by European Commission Eurostat. As a result, the European Union's new strategy for sustainable growth and jobs, Europe 2020, puts again innovation and green growth at the heart of its blueprint for competitiveness. The green economy comprises a myriad of jobs and it could be concluded that the growth of green jobs employment is in parallel with its intensification. The information in the National Reports suggests that employment in green economy as well as in traditional industries, which are becoming green, increases with sustainable rate and particularly throughout the recent years of crisis. Shifting workers out of the crisis-hit construction and tourism sectors and into "green and ecological" jobs is a priority; and this transition needs to be accomplished by implementing well-designed policies. In the Project Members' National Strategies on Employment, initiatives for increasing employment in green industries and the promotion of green jobs are foreseen. The National Reports agree that greening the economy and the corresponding education is a multi-dimensional challenge and therefore must be addressed through specific measures at the sectoral level that include targeted economic, employment and skills-development education policies. Particularly the Chemical Engineering should adapt its current curriculum programs to meet the new challenges and the needs of inclusion of the green chemistry and

engineering principles. One of the most attractive approaches to acquired new (green) competencies is to apply a mixed teaching strategy and courses in non-engineering university disciplines. In STRENGTH project 5 competence areas are defined per occupational field: Environmental Health and Safety; Biotechnology; Food Science & Technology; Agricultural Engineering; Pharmaceutical Technology. All these areas are closely related to Chemical Engineering and offer immense possibilities for chemical engineers to increase their curriculum with specific green skills.

The project "STRENGTH" complies with the urgent need for establishing of common innovative models and initiatives for VET to enhance qualification transparency and comparability. It launches innovative and coherent model for qualification description in knowledge intensive Chemical Engineering sector with high Green employment potential. This main aim of the project corresponds to the need analysis of the participant countries, focused on cooperation between VET and the world of work.

Development of STRENGTH e-platform

Stanislav Avsec, University of Ljubljana, Faculty of Education, Slovenia
Branko Kaučič, INITUT, Institute of Information Technology Ltd, Slovenia

A well known and established way of presenting information, hosting of services and dissemination are project websites. They are usual also one of the results of the projects. For the project STRENGTH partners of the project decided that it will serve as the core e-platform. Its main purpose is providing details about the project and the tool in order to promote project results provide broadening the circle of interested public and to achieve sustainability of the project.

In this part of the project a technical framework (e-platform) was developed in terms of design, planning, arrangement and operation (including approbation of demo and final versions) as a mutual concept of project consortium. The planned activities included five steps, each exploiting appropriate methods and techniques as follows: Preparation / planning; Building up; Deploying - transfer of the site to live server(s); Maintenance - scheduling the technical support regarding time, content, updating and financial resources; Evaluation of operation - review of feedback comments / errors, bug fixing, upgrading.

The result comprises the analysis of needs and expectations about the project site at first, development through the multi-step process and maintenance of the Project website.

The purpose of the website is:

1. to present general information about the Project;
2. to provide e-frame for implementation of smart decision logic for structured description of Chemical Engineering related Competences for Green jobs development;
3. selection of Green key skills and Competences and definition of smart decision logic for structured description of Chemical Engineering related competences for Green jobs development,
4. selection of key Green skills and competences and definition of benchmarks regarding specific EQF levels;
5. serve as a tool for formulation of Organizational / Individual Professional Profiles;
6. personal Qualification Records (PQR) and Competence-based Certificates;
7. operate as project e-database and device for information exchange;
8. allow sharing of experience and ideas within and outside the project network;
9. ensure project and post-project life actions via dissemination and exploitation of project outcomes.

As part of e-platform Project STRENGTH competency profiler was developed as an important tool and implemented as tool embedded into project website. Its functionality provides: job profiling, employee selection and retention, individual development organization, succession planning, employee training, performance management, and maintain corporate culture.

STRENGTH intelligent tool for competence description

Anna Kujumdzieva and Aleksander Savov, Intellect Foundation, Bulgaria

The economic activities related to reducing the use of fossil fuels, decreasing pollution and greenhouse gas emissions, increasing the efficiency of energy usage, recycling materials, and developing and adopting renewable sources of energy encompass the so called green economy.

An essential sector in this context is the Chemical Engineering. Chemical Engineering covers the fields of chemistry, materials science and process engineering.

It deals with innovative chemical processes, novel materials and new products that effectively function within their technological, economic, societal and social parameters.

To correspond to the current challenges of green economy trends the chemical engineers need greening their careers and making the outcomes of their professional development more sustainable.

Such prospects for green abilities adoption in a transparent and recognizable way offers STRENGTH competence matrix designed as an intelligent tool for competence description in Chemical Engineering sector. It offers those, who have already obtained basic / core knowledge and skills in Chemical Engineering through B.Sc. And / or M.Sc. programmes to further upgrade these achievements with precisely described green abilities - knowledge and skills, and their corresponding learning resources.

Five competence areas are selected to best fit the practical realization of chemical engineers in the main sectors of the green economy:

- Agriculture engineering
- Biotechnology
- Food science & technology
- Pharmaceutical industry
- Environmental health and safety

However, due to broad spectrum of economic branches where chemical engineers find occupation, this model matrix can be applied to other areas of economic activity as well.

For each competence area the competence matrix offers information about the chemical engineers' background prerequisite and courses that could be covered to allow green abilities adoption in this very area with the purpose to ensure better and more efficient professional realization. Choosing an area a trainee will have access to the set of knowledge, skills, and wider competences' description as well as relevant courses that offer the corresponding learning content.

Using this intelligent tool a trainee can generate his / her Individual Professional Profile relevant to trainee's prior knowledge and desired new one to be obtained via the training resources offered.

The tool tackles both EQF levels 6 and 7 at EQF using the ECVET principles to support individuals in developing abilities that meet the needs of the labour market.

STRENGTH mobility scheme

Trayana Nedeva and Roumen Pankov, Scientific Research Department of the Sofia University "St. Kliment Ohridski", Bulgaria

The STRENGTH mobility scheme reflects the vision of project consortium to emphasize on the transnational VET mobility as a sustainable part of project strategy for international recognition and validation of competences and qualifications. It is based on the documents issued by EC in respect to Erasmus+ Vocational Education and Training Mobility Charter 2015-2020.

The STRENGTH mobility scheme outlines the basic steps of a mobility procedure used as a basis for recognition and validation of competences acquired through performance of a training period abroad. It describes:

- The necessary planning and organizational steps;
- The obligations of the training providers in the home- and host institutions;
- The duties of the mobile learner;
- The set of documents that provide basis for understanding, implementation, and application of international VET placement.

In the mobility scheme the following phases can be outlined:

- **Preliminary phase** - establishment of partnership between competent training bodies / institutions; transmission of statement of purpose stating the general goal of the mobility procedure initiated, and signing of Memorandum of Understanding.
- **Preparatory phase** - Establishment of a Learning Agreement
- **Implementation Phase** - The mobile learner completes the preliminary negotiated in the Learning Agreement training programme.
- **Final Phase** - Return of the mobile learner to his / her home institution. Accumulation and integration of the newly acquired Learning Outcomes as a part of the Mobile Learner current qualification.

The set of documents encompasses:

- Memorandum of Understanding template;
- Learning Agreement frame;
- Sending body specific documents;
- Training provider specific documents;
- Competence-based mobility Certificate;
- Mobile learner Personal Qualification Record (PQR). The PQR includes a set of documents certifying the accomplishments a trainee has achieved during defined study / training period. The PQR is a tool for tracking and accumulation in a common location trainee's work results, a show-case of trainee's efforts, progress, achievements, responses, (self)assessment. It is a means for bringing together interrelated knowledge and experience with green job-related competences in Chemical Engineering. The Record is a multi-purpose instrument that can be used by trainees to track their own progress on achievement of certain competences during a training period; the trainer to mainstream the training process; and the potential employer to evaluate nominations for a target job position.

STRENGTH model testing and validation

Anna Kujumdzieva and Aleksander Savov, Intellect Foundation, Bulgaria

One of the main objectives of STRENGTH project is to organize and carry out approbation and evaluation / validation of the core project deliverable - STRENGTH model for description of the acquirable steps of competence development in Chemical Engineering domain for green jobs development.

The approbation and evaluation / validation assure measures through which the accomplished work receive a feedback from project direct beneficiaries and promote the final tuning of project results.

The objectives of the testing and validation stage are:

- To assess to what extent the STRENGTH model can serve as a practical tool, applicable in another competence areas, which need professionals with green abilities;

- To promote team self-assessment of STRENGTH model implementation, identification of related strengths and weaknesses, and directions for final improvement;
- To incorporate project target groups' recommendations and comments in STRENGTH intelligent tool for competence description.

The activities of the testing process encompass the following procedure:

- Preparation of information package - written instructions
- Performance of evaluation events for piloting and exploitation of project results / products
- Issue of national reports on the basis of the accumulated data concerning:
- the progress against objectives;
- satisfaction with the impact and outcomes
- the functionality and operation capacity of the STRENGTH model,
- Elaboration of analysis statement - issue of recommendations for final tuning of project results.

The testing and validation results have shown performance of 5 evaluation events within the period May - September, 2015 with over 70 participants on evaluation subjects related to Competence development in Chemical Engineering; structural description of work-related competences; Organizational / Individual Professional Profiles generation; Job profiler operation; Mobile Learner Personal Qualification Record assembly. The type and mode of evaluation were On-line / off-line; Web-based / Synchronous / Paper based (Tutorial). The feedback results were gathered by two types of questions concerning the interest in the project aim and objectives, and project competence model functioning and applicability.

The general opinion of the evaluation events participants graded STRENGTH model as a practical tool, with potential to be applicable also in another competence areas, which need professionals with green abilities to correspond to the increasing demand of the labour market for sustainable thinking and acting in all spheres of economic activities.

STRENGTH Project Management Guide

Trayana Nedeva and Roumen Pankov, Scientific Research Department of the Sofia University "St. Kliment Ohridski", Bulgaria

STRENGTH Project Management Guide promotes planning, monitoring and coordination of all project activities, distributed by partners, tasks and time according to the management plan. The Management Guide comprises written instructions for arrangement and keeping of project documentation dossiers at each Partner with the purpose to enhance the local management of project overall activities and facilitate the compliance with the deadlines and quality criteria for execution of project tasks.

The Management Guide includes:

- Project documentation dossier: a template to enhance the local management of project overall activities and facilitate the compliance with the deadlines and quality criteria for execution of project tasks. Dossier files include official project documents, project specific activities general documentation, instructions for managerial, financial and specific activities, partner's daily activities, partner's specific activities, project results and products, project valorisation, financial documents.
- Stage / Team plans: documents elaborated to outline project activities foreseen for 6 month periods following TMNs, distributed in project stages, WPs and responsible partners.
- Detailed time schedule chart of project activities, distributed by WPs and PUs: prepared to enhance the local management of project overall activities and facilitate the compliance with the deadlines and quality criteria for execution of project tasks.
- Guidelines for project financial management: instructions to serve as a practical guide for sound financial management of project activities on the basis of Spanish National Agency regulations. The guidelines include: basic rules, project financial cycle, project monitoring, income and eligibility, categories of eligible costs and budget changes
- Intellectual Property Rights and Valorisation Agreement template documents, which determine partners' responsibilities and rights in respect to project specific products.

The management guide is the cornerstone for successful development of all Work Packages, efficient diffusion of information, building of consensus between the actors and final promotion of the initiatives to the wider public. Thus, it facilitates the work of the project structure for transnational management and coordination. This structure comprises:

- Project Steering Committee that prepares and put into action the overall work plan for operation and administration of project activities.
- Partners' Units that govern the project work and assure its daily functioning at national / local level.
- Dissemination and Exploitation, and Quality Management Groups that organize and put into practice all measures planned by PSC regarding the valorisation and quality management strategy implementation.

STRENGTH Quality management, monitoring and evaluation manual

Anna Kujumdzieva and Aleksander Savov, Intellect Foundation, Bulgaria

STRENGTH Quality management, monitoring and evaluation manual identifies what quality control tasks are needed along the project advancement; schedule and controls the tasks assigned; assures that all contractual quality standards and inspections are met; and documents what is required to consistently achieve quality.

The manual facilitates the supervision of the progress and integrity of individual WPs through provision of specific guidelines for the type and frequency of evaluation reports as well as evaluation methods for the examination of project achievements.

The Quality management, monitoring and evaluation manual includes:

- **Work Progress Key Indicators (WPKIs)** with the purpose to determine qualitative criteria and measures for smooth and in-time project advancement.
- **Guidelines for authorization of WPs and criteria for assessment of project progress and integrity**. These are foreseen to ensure that work is started in the correct time, it follows the correct sequence and is done by the designated responsible (individual, partner, management structure, etc.). The guidelines serve as a key communication link between the tasks executors and the

governing individual / body the latter confirm the scope, the schedule, and the human and financial resources for these tasks.

- **Internal audit plan** assigned to help project consortium to accomplish project objectives applying systematic approach to evaluate and improve the effectiveness of project internal control and risk management. Its objectives persuade effectiveness / efficiency of project tasks; reliability of management reporting and minding of WPKI; identification, gathering information about, analysing, and monitoring strategic risks; compliance with applicable legislation; safeguarding of project deliverables.
- **Communication plan** implemented to introduce measures for effective and efficient communications with the various audiences having a major stake in the project. The plan outlines the communication network of the project; defines the communication activities based on roles and frames of information distribution, and its sharing within appropriate audiences on a timely basis by the most effective instruments; supports good corporate and community reputation of the STRENGTH project and ensures that project messages are correct and timely delivered.
- **Evaluation grids for determination of project state of development**. It determines the state of development of project activities by consortium members in terms of products / outcomes foreseen.
- **Project progress evaluation questionnaire** that helps members of consortium to improve the quality and overall management of the project, and to foresee putative problems that may arise in the project advancement. It is designed as a tool for gathering project team opinion for the tasks performance within different work packages along project development.

Dissemination strategy and tools used to communicate the STRENGTH project's results

Nikolay Vassilev and Maria Vassileva, University of Granada, Spain

The "STRENGTH" Project aims at introducing a synergic transfer of an existing model training system (Vocational Qualification Transfer System in Public Health) for workplace basic skills development within the Chemical Engineering. The reason is that National and European systems for vocational qualifications do not offer

successful strategies for obtaining the necessary skills, but the learning process is getting loaded with increasing complexity, contradictory requirements and obscure criteria. The partners in the "Structuring of work related competences in chemical engineering" - ("STRENGTH") Project have decided to strengthen the European workspace by improving transparency of certificates and qualifications, obtained in the European states. A special work package is included in the Project which aim is implementation of Project objectives and assurance of their sustainability through optimization of results / outcomes value and enhancement of their impact and integration into National and EU VET systems. Due to the variety of target groups the project addresses its implementation which requires multi directional information flow. To fit this requirement an effective dissemination plan is designed (with the corresponding tools) considering the type of materials / information to be prepared / issued - channels for main-streaming the information flow; target groups / end-users and potential beneficiaries to be addressed.

The result includes STRENGTH Dissemination Strategic Guideline and Exploitation Plan which reflects the vision, mission, goal and strategic thrusts that are based on the main objectives of the project (templates for recording and monitoring valorisation progress; organization and performance of national / international workshops for dissemination and exploitation of project achievements).

Discussion and conclusions

The STRENGTH project initial objectives were met through development of innovative and coherent model for qualification description in knowledge intensive Chemical Engineering sector with high Green employment potential, focused on cooperation between VET and the world of work. The programme general objectives were met through supporting improvements in quality and innovation in systems, institutions and practices of education and training. The project encourages cooperation in recognition of adopted learning and mobility within educational / training systems in Europe. The programme operational objectives were met through improving transparency and recognition of qualifications and competences, including those acquired through non-formal/informal learning. It promotes application of EQF, EUROPASS and ECVET in chemical engineering making sustainable the development of the national/sectoral qualification systems. The project contributes as well to the enhancement of the process of mobility facilitating the transfer of vocational competences acquired abroad via STRENGTH model. Thus it supports the harmonization of the mobility process at EU level. The project contributes to raising

awareness in the target groups for importance of transparency and comparability of qualifications for Green jobs and necessary changes in EU labour market and society in respect to the role of VET in professional development. STRENGTH project attained several over-objectives' achievements, namely:

- Case studies: selected educational material delivering education/training for chemical engineers in the predefined by project consortium competence areas; It was created in order to demonstrate the philosophy of the STRENGTH model to end users.
- Competence profiler: competency modelling tool that unifies several action steps and elements for competences implementation and utilization in a working context.
- Valorisation practices: networking with projects focused on VET delivery and competences/qualifications acquisition.

The achievement of overall project objectives is grounded on the project consortium composed of 5 partners from 4 countries, unified by the main project goal and organized on the basis of different experience in various EU initiatives, the technological and education background, as well as the expertise in project management and administration. The experience and know-how of each partner, in respect to its professional competence, as well as the country-specific practices contribute to the achievement of project objectives through performance of purposely allocated specific activities, distributed by time and Work Packages in 5 interrelated operational phases. All project partners dynamically participated in planning and performance of the intelligent tool testing; assessment of model applicability and usefulness; performance of active valorisation at regional / national level and wide spreading of project achievements throughout Europe.

The following unanticipated benefits (spin-offs) of the project were realized:

- Establishment of new opportunity for realization of novel type of competence description for continuous upgrade and certification of professional achievements in the field of Chemical Engineering.
- Encouraging the implementation of national / EU standards for structuring the transferable and transparent VET qualification description in Chemical Engineering.

- Promoting the sustainability of Chemical Engineers' outcomes of professional development by offering opportunities for greening their careers in response to the current challenges of green economy trends.
- Creation of preconditions for implementation of the new ERASMUS+ programme.
- Regional development: quality improvement of VET at EU level through on-line access to structured description of competences and strengthening the regional literacy in the field of Chemical Engineering, thus improving the economic conditions.
- Networking: building of transnational relationships with a number of universities, R & D centres, SMEs, etc. in Europe (see Dissemination activities reported), planned to function beyond project life.
- Clustering: several projects have been selected to introduce the results of STRENGTH for effective mainstreaming of its results / outcomes.

The estimation of the expected sustainability of project results is based on the results obtained upon performance of project testing and exploitation of results activities. The data gathered after approbation of project Results 2 – 4 indicated interest in project competence generating tools and mobility scheme application at academic level (in higher educational establishments) as well as at Large and SMEs. The feedback received after distribution of on-line information and printed dissemination materials to various end-users and target groups allow the estimation of the above mentioned figures. The innovative model for structured description of competences for green skills acquisition developed by STRENGTH project is welcome by the potential users. It offers opportunities these targets to improve their conceptual knowledge in tailoring personal competence / job profiles for career prospects and mobility realization.

The achievement of sustainable impact of the project results after its funding is expected to be reached through project dissemination and exploitation activities performed by the partnership in the form of specific targets-oriented activities focused on selected groups, economic sectors and types of institutions. The project partnership worked very efficiently together for project realization. It plans the following activities to be performed:

- Maintenance of project consortium during post-project life on voluntary basis.

- Keeping the project web panel operable beyond the project funding period and long-term support of information about project products/results.
- Implementation of the project products/results into national educational systems.
- Network formation and organization of project valorisation events.

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V-STRENGTH

International virtual conference on green jobs and work related competences in chemical engineering

1. Project STRENGTH

PRESENT STATUS AND CHALLENGES OF THE LDV "STRENGTH" PROJECT: WHY "STRENGTH"?

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Abstract

The EU education policy was reinforced by linking up education and training with labour market needs. The recent trends in this field are reflected in the European Policy Agenda, and are connected to the need for development of knowledge-based economy. Among the important factors influencing this policy are: i) ageing of the population, ii) increasing demand for lifelong learning opportunities iii) shift of the system from "knowledge" to "competence" and from "teaching" to "learning". These changes have stimulated the demand for workers' knowledge and skills upgrade. However, the success of the lifelong learning programs has been hampered by the lack of cooperation between educational providers and national authorities. Students and workers could not use their qualifications in other countries due to the lack of transparency. The project "STRENGTH" complies with the urgent need for establishing of common innovative models and initiatives for VET to enhance qualification transparency and comparability. It launches innovative and coherent model for qualification description in knowledge intensive Chemical Engineering sector with high Green employment potential. This main aim of the project corresponds to the need analysis of the participant countries, focused on cooperation between VET and the world of work.

Keywords: chemical engineering, green jobs, green skills, project STRENGTH

Introduction

The STRENGTH project aims at introducing a synergic transfer of an existing model training system (Vocational Qualification Transfer System in Public Health) for workplace basic skills development within the Chemical Engineering field keeping green abilities awareness in four EU countries - Spain, Bulgaria, Slovenia, and England, regarding the shift of the European labour market towards knowledge-based

economy and sustainability of jobs. The STRENGTH project provides strategic advice on formulation of a green economy strategy, engaging global best practices and making connections to global network of green economy lessons learned. It analyses the global trends in green economy with focus on clean technology investments and fiscal instruments to generate efficient use of energy, water, mining, building, transport, and wastes.

The project objectives are focused on introduction of the "green abilities" concept to create new opportunities of vocational education and training (VET) teachers and systems to build up green employability skills and further ecological awareness development in job seekers. In this way participants in VET will acquire knowledge for new generic employability and green skills for performance of personal development, employability and introduction in the European labour market.

Chemical Engineering as an academic discipline

Chemical engineering, as an academic discipline, involves the design and management of biological, chemical and physical processes that enable raw materials to be converted into valuable products. It is a discipline that is based on scientific knowledge from chemistry, physics, biology and mathematics combined with engineering principles. Chemical engineers design both products and the processes and manage their operation and optimization in order to ensure that they are economically viable and environmentally acceptable. On the other hand, the processes that are managed, as a part of the designed plant, include biological and / or chemical reactions in a sequence that provides minimal loss of materials and consumption of energy. The same unit operations are equally applicable across industries such as petroleum / petrochemical industry, food processing, mining and related industries, production of plastics and chemicals, pharmaceuticals production, environmental management, and biotechnology where, in some cases, additional skills of the chemical engineer are needed. It is important to note that Chemical Engineers must be capable of reacting to any change in production conditions and partly because the Chemical Engineering is closely related to discoveries in the enabling sciences of the profession such as biology, chemistry, biochemistry, microbiology and physics. Hence, the chemical engineer must be familiar with the language and principles of these sciences (at least to acquire additional specific skills)

and / or to be able to work closely with specialists from these fields and other fields of engineering, management and industrial relations.

Green Chemistry and Jobs: Definition, current state and future trends

In general, Green Chemistry (including Chemical Engineering) can be defined as the "design of chemical products and processes to reduce or eliminate the use and generation of hazardous substances" and illustrates the 12 principles of Green Chemistry, a set of "design rules" which illustrate that field, announced in 1998 by Paul Anastas and J.C. Warner [1]. Bearing in mind the "engineering part" of Chemical Engineering, it would be of great importance to additionally include the 12 Principles of Green Engineering elaborated by Anastas and Zimmerman [2]. It is clear that Green Engineering is the development and commercialization of industrial processes that are economically feasible and reduce the risk to human health and the environment. All the above principles should be taken into account when determining the details of the STRENGTH Project Matrix of Green Competences. To analyse historically the development of the concept of Green Chemistry it would be interesting to use database of scientific publications generated along the last 20-30 years. The evolution of Green Chemistry scientific publications increased from less than 100 in 1990 to more than 600 in 2012. On the other hand, if we examine the distribution of these articles by field it appears that the majority belong to Chemistry Multidisciplinary while only 3.75% of the total number belongs to Chemical Engineering [3].

One of the first and widely accepted definitions for "green jobs" particularly by research and policy-makers is the one from the report by the United Nations Environmental Programme (UNEP), International Labour Organization (ILO, International Trade Union Confederation (ITUC) and the International Organization of Employers (IOE). The report defines Green jobs as jobs created, under decent work conditions, in activities that reduce environmental impacts of sectors, companies and economies. The definition further considers green jobs as "green" positions in agriculture, manufacturing, construction, installation, and maintenance, as well as scientific and technical, administrative, and service-related activities that contribute substantially to preserving or restoring environmental quality [4].

It should be noted that "green jobs" are widely recognised as an evolving concept and therefore it is difficult to give a strict definition valid in a long-term. The definition

of "green jobs" in wider context might comprise any new job in a defined sector of economic activity, which has a lower than average environmental sign and at least partly contributes to improving overall performance. Due to this broad interpretation of the subject the counting and monitoring of the numbers of green jobs is a tricky task. A new job maybe greener than a previous, yet not green enough. Here, the pure statistics of direct green jobs counts less than the support of the idea that sustainable development transforms employment patterns and the labour market. Namely, this process at EU level is continuous and positive.

Another issue is the quality of green jobs. At present, many green jobs are still informal (mainly those connected with recycling, construction, biofuels production). This highlights the complicated route of achieving sustainability. In other words it is not possible to address the environmental dimension without also focusing on the national and international social and economic policies regarding decent work conditions. International labour standards provide practical guidance for green jobs, particularly instruments on safety and health, chemicals and on working conditions. Thus, one of the key challenges is to ensure that the green jobs are decent work and contribute to socially sustainable development.

The EU has devoted more public research resources to environmental-related sciences than any other research system in the world. According to the data available, there are about 7,360,000 jobs in the EU in green sectors but there is still a gap between the potential for eco-innovation and the current state of "green-based" activity. It should be noted, however, that there was, until recently, a lack of based on a reliable, comprehensive and comparable system of green jobs evaluation in the European Union. The lack of a standard data definition of green jobs resulted in highly differing figures for present green jobs and future potential in the EU [5].

Undoubtedly, Green Jobs are an important part of the employment linked to a more environmentally sustainable economy. On the other hand, they are critical for making the shift to Green Economy in general, and Green Chemistry in particular, and technically feasible and economically viable. One of the most critical points in this process is that without skilled and motivated workers in new green growth sectors and in key occupations across the economy, the investment made and the technology deployed will not generate the expected benefits for sustainable development. The manufacturing sector has a huge potential for greening. Managing materials in a green way implies not only recycling but looking at the composition of materials

themselves. Materials science and in particular green chemistry is a growing area where new skills are emerging as technology advances. Production processes become green when green technology and improved materials are applied, outputs of waste and inputs of energy and resources are reduced, and account is taken of products and materials throughout their entire life. Occupations affected by these changes vary from one industry to another, but across the sector include those of executive manager, researcher / developer, engineer, industrial technician and machine operator. Other related occupations where skills are likely to change include those of chemical engineers, chemical equipment operators and tenders, chemical plant and system operators, chemical technicians and chemists.

The need of Green Skills introduction into Chemical Engineering education

"When will ecologists learn engineering and ecologists learn ecology?" William Mitsch, Editor-in-Chief, Journal of "Ecological Engineering"

Experts in the field of education in general, and in Chemistry and Chemical Engineering are split over which is more desirable: specific green chemical skills training or a more general background including more specific subjects different from the traditional ones. Production industrial sectors are divided by the same manner. Some years ago the journal Nature published a special report on Green Chemistry [7] citing hiring managers of some important companies. For example the hiring managers at the multinational General Electric, green qualifications are less important than raw talent while others say green chemists have some advantages, including greater awareness of environmental issues. It is now widely accepted that students following the Green Principles in their education in green chemistry are uniquely positioned to address industry concerns because of their specific training in both industry regulations and particular process constraints.

Another important point concerning the need of green skills implementation is job creation in the field of Chemical Industry bearing in mind the steady decline of students in chemistry titles in Europe. It is not a secret that chemistry has not been a popular career choice in recent years worldwide. Particularly in Europe, with 1.7 million people employed in the chemical industry in the 27 countries of the European Union, the industry is fighting to remain a competitive employer. To avoid the radical decline in chemical industry employment, the European Technology Platform for Sustainable

Chemistry (SusChem; http://www.suschem.org) clearly promotes novel skills such as expertise in biocatalysis, process design and nanotechnologies. To increase work in these areas, SusChem hoped to boost the European Union's funding of training and research in chemistry by 75%, to 5.5 billion euros till last 2013. SusChem fully supports the Innovation Union and the goals of the "EUROPE 2020 Strategy" addressing direct technical innovation areas and two supporting areas such as Resource and energy efficiency; Water; Raw materials; Smart Cities; Enabling Technologies; and Education.

In order to meet the Horizon 2020 goals, innovate successfully, and remain sustainably competitive the European chemical sector needs human resources equipped with the right mix of skills. Motivated by recommendations in the report of the European Commission's High Level Group on the Competitiveness of the European Chemical Industry published in July 2009, the Chemical Industry Council (CEFIC) published a study which aimed to investigate the critical - business, personal, scientific and technical - skills that scientists and engineers will need to boost innovation in the European chemical industry of the future [8]: it is clear that the main need concerns Multidisciplinary / Interdisciplinary Broad Skills set introduction into the Chemistry Curricula.

One of the most important conclusions when analysing the available literature on Green Chemistry, Green Jobs, and Green Skills is that there is an urgent need to design appropriate educational schemes and resources that can be used at undergraduate and Master's level to develop the skills needed the chemical industrial sectors. In support of the above, let's take Ecological Engineering, which should obligatory include Green / Sustainable Concepts. Ecological engineering is defined as the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both [9, 10]. The goals of ecological engineering are well defined as: (1) the restoration of ecosystems that have been substantially disturbed by human activities such as environmental pollution or land disturbance, and (2) the development of new sustainable ecosystems that have both human and ecological value [11]. Particularly the development of new sustainable ecosystems makes ecological engineering broader. According to Prof. Mitsch, who is an expert in Ecological Engineering and the Editor-in-Chief of the journal of Ecological Engineering, "ecosystem restoration, as currently practised throughout the world, is done by practitioners who have little experience in design (scientists study systems, they do not design systems) and by engineers who do not appreciate the capabilities

of ecosystems to self-design (engineering is a field devoted to removing uncertainty and controlling natural processes)" [12]. The approaches of many restorations projects that are less successful than anticipated are over-designed by engineers with unsustainable technology. The main conclusion of progress evaluation of six long-term restoration projects in the USA, is that for this kind of ecological activities to become more accepted and predictable, they need to be better integrated and more trans-disciplinary-organized in Universities. It appears that ecological engineering academic programs controlled by engineers alone are unsuccessful because of the lack of both ecological and biological training in traditional engineering programs. Similarly, the field of restoration ecology should provide more allowance for emerging ecosystems, and "not always focus on putting things back to the way they were". Design and problem solving of mega-ecological problems are needed in the fields of ecological engineering and ecosystem ecology. Engineers and scientists should recognize the importance of the naturally occurring self-design and accept time as a component in ecosystem development when designing projects aimed at creation of functional ecosystems. These expert recommendations based on long-term observations of in fact green-oriented activities illustrate the urgent need of reconstruction of both Engineering and Ecological Curricula in order to create more sustainable and science-based Green Education in Universities. Similar conclusion can be made following the most recent evolution of the trajectory of "green articles" which shows that in the field of research Green Chemistry in general broadens its focus (in particular to the field of biocatalysis) and is trying to work at the intersection of different knowledge fields or principles.

Active skills policies will therefore be important, with the main lessons pointing to the need of anticipating future skills requirements and make adjustments in education and training systems. In the field of Chemistry, Chemical Engineering, and Biotechnology the value of encouraging the acquisition of generic skills in science, technology, engineering and mathematics (skills defined as STEM skills) is an important task as well as the urgent need to boost green skills development as an adaptive response to the rapid climate challenges. An excellent example in this direction is the initiative of the OECD that has created a Forum on Green Skills, bringing together stakeholders in skills development for a low-carbon economy [13].

THE STRENGTH PROJECT - Need analysis and conclusions of Project National Reports

As a part of the STRENGTH Leonardo da Vinci Project, a short analysis of the above information and of a set of National Reports elaborated to determine the need of green jobs, and particularly in the field of Chemical Engineering Education and Industry, has been carried out.

The European Union green good and services sector more than doubled in size in the last decade, according to latest figures released by European Commission Eurostat. As a result, the European Union's new strategy for sustainable growth and jobs, Europe 2020, puts again innovation and green growth at the heart of its blueprint for competitiveness. The green economy comprises a myriad of jobs and it could be concluded that the growth of green jobs employment is in parallel with its intensification. The information in the National Reports suggests that employment in green economy as well as in traditional industries, which are becoming green, increases with sustainable rate and particularly throughout the recent years of crisis. Shifting workers out of the crisis-hit construction and tourism sectors and into "green and ecological" jobs is a priority; and this transition needs to be accomplished by implementing well-designed policies. In the Project Members' National Strategies on Employment, initiatives for increasing employment in green industries and the promotion of green jobs are foreseen. The subsidising employment in green jobs was launched in all Partners countries simultaneously including them in the national classification of professions.

The mechanisms behind Green Chemistry, including Chemical Engineering, are based on a set of principles dedicated to creating more efficient industrial chemicals, drugs and products, and govern by a mixture of political, economic and cultural factors. The economic drive is to reduce waste. The political drive comes from regulations, existing in all Project Partner Countries, which are forcing companies to develop cleaner processes. The green economy development requires technological innovations in production as well as economic and social infrastructure based on national legislation -adopted in all countries in the last years. Finally, consumers and scientists who are becoming more aware of the need for cleaner processes provide the cultural drive. Demands for engineers, scientists and technicians are set to boom. For example, UK will need 100,000 new engineers by 2020. If industry is to adopt green chemistry technologies, today's students must be trained to design products

and processes that do not use hazardous substances. Through green Chemical Engineering education, a new generation of chemical engineers will be better equipped to meet tomorrow's scientific challenges.

Although the benefits of implementing green abilities in the companies and use green technologies are still not convincing for business managers and investors, there is increasing pressure in industry for companies to become more sustainable by developing environmentally friendly products, minimizing waste, using renewable resources, and to maintain cleaner processes throughout. However, there are no explicit overarching national strategies targeting the green abilities needs. There is a lot of variety among Member States in skills programs for green jobs due to their differing social, economic and environmental conditions-some Member States are moving faster than others. The general abilities for several groups of professions, related to Chemistry / Engineering, are common. The "green" abilities are grouped for a set of professions, thus fitting the requirements of STRENGTH project for defining professions that share common special abilities. The institutions, involved in education of professionals working in the above-mentioned sectors, are Universities and other higher educational units and the adopted qualification by the specialists is in compliance with level 6 of EQF.

The National Reports agree that greening the economy and the corresponding education is a multi-dimensional challenge and therefore must be addressed through specific measures at the sectoral level that include targeted economic, employment and skills-development education policies. Particularly the Chemical Engineering should adapt its current curriculum programs to meet the new challenges and the needs of inclusion of the green chemistry and engineering principles. One of the most attractive approaches to acquired new (green) competencies is to apply a mixed teaching strategy and courses in non-engineering university disciplines. In STRENGTH project 5 competence areas are defined per occupational field: Environmental Health and Safety; Biotechnology; Food Science & Technology; Agricultural Engineering; Pharmaceutical Technology. All these areas are closely related to Chemical Engineering and offer immense possibilities for chemical engineers to increase their curriculum with specific green skills. For example, it is possible to move the present state of knowledge in Biotechnology University Education to a different state where Chemical Engineering and Biotechnology specific green skills could be are combined to form novel functional characteristics. The Food Science and Technology field of

Science and University education could train Chemical Engineering specialists to be able to optimize and innovative processes and products, as well as to manage materials, products and wastes from the food industry. Similarly, Chemical Engineers can acquire additional knowledge and green skills in the fields of Agricultural Engineering, Pharmaceutical Technology, and Environmental Health and Safety.

The central point of the Project STRENGTH is to develop a Qualification Record based on competences related to green abilities that a chemical engineer could additionally acquire and, in addition, a Mobility Scheme that reflects the vision of the STRENGTH Consortium on the transnational VET mobility aimed at international recognition and validation of competences and qualifications. The description of the competences on the various steps of competence development takes place in a context-related manner. STRENGTH model core work tasks are comprehensive tasks within the green jobs context a person with the respective occupational profile has to deal with. Thus, the descriptions of the competences are designed to form a clear picture of how they can be applied in the green jobs context. The descriptions include green jobs-related categories to clarify the work activities in the Chemical Engineering field. It is important to note that while the common competences describe what a trainee, completed a full training programme in Chemical Engineering area should be able to do, the green competences specify the knowledge and skills trainees in a defined Chemical Engineering area should have in green-jobs related context. Both types of competences are covered through the accomplishment of specific study courses. Each competence is linked to the specific learning objectives of the relevant study courses. As the Chemical Engineering specific competencies are interdisciplinary by nature, for many of them one and the same specific course is required to be covered. The Project also includes a Competence Profiler unit. Being formed from defined parts of a Competence Matrix, the competence profiles generally cover certain part of all competences described in the Competence Matrix. The organizational profile is formed by identifying competences relevant for the corresponding qualification. It is foreseen to be in compliance with the requirements of the authorities responsible for the respective qualification. The individual profiles reflect the competences that can be acquired by an individual in training.

The STRENGTH Project members do hope to provoke interest in the National and European authorities, students, professional organizations, and enterprises in order to make more attractive and greener the Chemical Engineering education and work.

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IMPORTANCE AND LIFE-CYCLE OF THE PROJECT WEBSITE

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Abstract

A well known and established way of presenting information, hosting of services and dissemination are project websites. They are usual also one of the results of the projects. Therefore it is important that they are appropriately designed and implemented. Several guidelines and tutorials exists about that, mostly dependent of area of interest and target audience. For the project STRENGTH partners of the project decided that it will serve as the core e-platform. Its main purpose will be providing details about the project and the tool in order to promote project results, provide broadening the circle of interested public and to achieve sustainability of the project. The contribution represents the analysis of needs and expectations about the project site at first, then the three iterations of the project website current life-cycle and future maintenance, its organisation and finally the report about their usage and lessons learned about the project websites.

Keywords: project website, needs analysis, website design, website life-cycle

Introduction

Last three decades, the development of information technology extremely changed the daily lives and life style of human beings and revolutionized organizations and overall economy. A new area of information age (some call it "information explosion"), responsibilities and opportunities started by the Internet and the World Wide Web as its most important service. Web is becoming the greatest communication medium nowadays and platform for people to acquire knowledge and explore information. Demands for new network services, their solutions and applications expand at the unprecedented speed and Internet now hosts the largest portion of informative data around the world.

Hundreds of millions of repositories of information called "websites" or "webpages" form a complicated information system from which people can gather

needed information. According to some organizations (e.g. NetCraft, www.netcraft.com) the quantity of websites exceeded billion pages already in 2014 and is still increasing daily. Similar is for users, number of internet users, network traffic and network data storage. It is faster to search and extract information from websites than looking up for information in classical library. The fast growing number of internet users presents education and business opportunities while the fast growing number of websites leads to awareness that website is not just intuitive product but rather carefully conceived project. Namely, websites can among other things gain strategic advantages for individuals and organizations, can facilitate institutional and political change, can attract prospective applications, can build communities, share knowledge, solve critical life issues, spread the news, etc. Websites are widely recognized mediator to proliferate the desired information to the user or customer.

European Commission funded projects address different aspects, individual and professional, individual and organizational, theoretical and practical, with short- and long-term visions, etc. As it is usual, project websites are one of the projects results, and are well known and established way of presenting information, notifying, dissemination and broadening the circle of interested public. They can have only basic role of project's presentation, or they have more complex role (e.g. e-learning, training centre, discussion area, etc.) and they are maybe of assistance or a tool for achieving some other project results. In 2013 started the Leonardo da VINCI TOI Project STRENGTH (Structuring of Work Related Competences in Chemical Engineering), 2013-1-ES1-LEO05-66726 (www.greenstrength.eu). Project core activity is to map and describe "green abilities" for sustainable economy. Basically, project tends to provide enough information for people to improve their knowledge and skills and be more competitive in labour market or even innovate and start their own new challenges. In order to meet the main aim the project anticipated the project website as one of the mechanisms for end-users.

The success of website is closely related to the needs and expectations of users. For this purpose, a survey about project website expectations was conducted. The paper presents the literature overview about websites followed by the main topic, the survey results and project websites versions representing the life-cycle and the report about website usage.

Literature overview

The nature of world wide web is such that any type and diversity of information can exist, simple or complex interconnected. An extensive amount of research papers exists reporting different aspects of websites. Establishing the website that is attractive with efficient functions and functionality and fits in with general or specific user's needs is a global topic that has been discussed and disputed constantly.

Success of information systems and websites have been point of interest for decades [19, 26] and still is. Among research endeavours, usability and interactivity have been examined most predominately [32], while some researchers tackled the websites through theory of human-computer interaction [21]. There are several types and purposes of websites (e.g. information, identity, education, community, and entertainment sites [14, 17]). Some of types are blogs which in some period exhibited over 50000 new blogs per day (European "blogsphere") and wikis which are specific in usage although both types with vast possibilities [11, 20]. General lesson applicable to most website is the need to have a very clear set of objectives from the outset. Example of setting and meeting objectives and life-cycle is presented in [2]. The importance of attracting new users, trust to website, identification of users with the website and how retaining them is critical for the success is given in [10, 18]. Critical factors influencing diffusion of interactivity innovations on corporate websites is studied in [32]. Among critical factors is also the design of link structure which can be optimized also with mathematical models [7, 33]. Websites fight for higher visibility which can be achieved also by efficient search engine optimization techniques [15]. There are issues that have to be considered when website offers courses and for example distance learning [8]. How users feel and use the websites according to their sex, differences is observed in [27]. Since websites and their users are spread all over the world, culture effect on websites have to be considered also [16]. Aspect of comprehensibility is covered in [35]. Since number of websites have grown in size, website abstraction or summarisation is of great importance for fast end efficient web browsing and retrieval [3]. Some aspects of advertising are covered in [6]. More and more web content is dynamic and more attractive and interactive websites exists, which are not all suitable for all users. Users with disabilities are mentioned in [23]. Hardware requirements and how to identify website capacity can be found in [24], and example of performance improving in [34]. The theory of rhetorical situation to examine the impact of internal organizational communication on website design is

reported in [19]. Importance of maintenance and how to manage the maintenance of websites that need input from many stakeholders briefly described [22]. A proposal of website usability testing on case of library website can be found in [28]. How important is assessment and feedback from users and how website can be improved based on that shows [13]. User's feedback concerning website quality is also in [17], while the quality of website was observed with standard ISO / IEC 9216 (evaluation of software quality, now replaced by ISO / IEC 25010:2011) in [30]. Awareness about "green web content" is growing and it is becoming increasingly important to have website "green" as possible. A study in [4] shows how visualization technology Flash influence the power consumption.

Significantly small amount of research is reporting about development of websites. In [29] authors applied the ADDIE model (analysis, design, development, implementation and evaluation), while the Anderson described the life-cycle via "common sense" [2]. Lastly, websites have to apply to all necessary laws, they present intellectual property, copyrighted materials and informations, data protection, user protection, service protection, etc. which is for some website especially critical issue [5]. On the contrary, some websites don't have honest intentions and tools for detecting fake websites and fraud exist [1, 9]. Security issues and specific types of vulnerabilities are also mentioned in [31].

More information and useful references one can found in [19, 25, 32]. However, in authors opinion the most important document that designers, content providers and other stakeholders of websites should follow is the new standard ISO / IEC / IEEE 23026 [12]. The standard defines system engineering and management requirements also for the life-cycle of websites including strategy, design, engineering, testing and validation, and management and sustainment for intranet and extranet environments.

Needs analysis

The purpose of needs analysis was to obtain information regarding the appearance and organization of information of the project website through the requirements and expectations of website users. Mainly, the organization of information is closely related to the project content and products and what will be pointed out and emphasized to the general public.

Website users will be project partners and other users, so called end-users. Among them, partner users and end-users differ in knowing information about the project and their general role - partner users represent the side of information holder and service provider and are familiar with aim and objectives of the project and project's website. End-users on the other side act as recipients of information and service users. Therefore their requirements and expectations are fundamentally different.

Information from both groups of users was obtained by the survey. For each group separate questionnaire was prepared. Due to international consortium of project partners these questionnaires were identically prepared in official languages of project partners. Implementation was as online questionnaires, if necessary partners could get written versions also. Because of using online questionnaires, collecting responses was easier; however, we were aware of disadvantages of this (possibility of not serious or false solving, possibility of errors, reducing the concentration, etc.).

Since this was a qualitative research in order to identify the information for establishment of the project website, the survey does not provide hypotheses, but it will answer the following research questions: (1) What is the benefit that both groups of users they expect from the project website? (2) What kind of information both groups of users expect to be at project website? (3) With what kind of content and website elements will be the expected information realized? (4) What content will be accessible only to the partner users? (5) How it will be evaluated the success of the project website at the end of the project?

The work was done in the following phases: (1) examination of websites of some other projects funded by the European Commission; (2) examination of information about the project STRENGTH from materials from partner P3; (3) preparation of draft questionnaires in Slovene language; (4) pilot solving the questionnaires from one end-user and one partner user; (5) changes of the questionnaires based on the feedback from pilot solving; (6) review of the questionnaires from methodology expert at partner P3; (7) changes of the questionnaires based on the feedback from the expert; (8) translation of the questionnaires; (9) review and approval of the questionnaires by the project coordinator; (10) translation of questionnaires and their establishment in a common website; (11) solving questionnaires, and (12) data processing of responses and preparation of the report.

Solving questionnaires was conducted from 28.01.-04.2014. Web address hosting questionnaires were sent to potential respondents by partners. After the completion

of solving the questionnaires all responses were transferred to a central location and grouped by groups of users. All answers were prior to analysis translated into a common language. Where it made sense, the responses were united on the basis of similarity of the meaning.

Instrument

The instrument was two questionnaires, one for partner users and one for end-users. Basis of the questionnaires is usual interview with questions when one orders production of a new website, supplemented with questions regarding the project STRENGTH. E-learning topic was deliberately omitted from the questions since it is not one of the results or products in the project.

Most of the questions were therefore open-ended and allow respondents arbitrary long and detailed answers. Only a small number of questions were closed type, where open-ended type would not make sense (e.g. choice to which partner belongs respondent, choice of gender, etc.), or it was expected from respondents to provide grade in predetermined range. Due to the different roles of partner users on the project, it was expected that some questions will be unanswered (e.g. the person who will be responsible for technical details is possible to have no opinions on some non-technical project issues, etc.). The questionnaire was anonymous for end-users while the questionnaire for partner users included questions about belonging to the partner, role on the project, role in their organization, gender and age group, which do not guarantee complete anonymity. Regardless of that, it is not expected that these questions will affect the answers. Since the focus of the questionnaires is the website of project STRENGTH, some areas and questions from both questionnaires partly or entirely overlap. The overlapping was intentional to identify differences in expectations.

Questionnaire for partner users

The questionnaire is comprised from five areas investigating the opinion of respondents about: objectives and message of project STRENGTH website; general perception of websites of other projects and project STRENGTH; wanted content and organization of web pages on website of project STRENGTH; expected usage of website from the end-users viewpoint and promotion of website, and basic

information of respondents and their experiences on projects funded by European Commission.

Questionnaire for end-users

The questionnaire is comprised from five areas investigating the opinion of respondents about: their employment and experiences on projects funded by the European Commission, and their opinion about green jobs, competence profiling and chemical engineering; expected content of project STRENGTH website; expected design of project STRENGTH website; general perception of websites, and basic information of respondents.

Order of areas and questions differs from questions for partner users because end-users are not familiar with details of project STRENGTH except with the information in questionnaire's introduction text. In the latter respondents learned only that primary purpose of the project STRENGTH is to determine structural model of professional competencies in the field of chemical engineering. Details about questions used can be found in [14].

Summary of analysis

The following analysis is divided according to semantic areas. The following are summaries of the responses from partner users and end-users as well as deviations in their responses and what should be taken into account on project's website.

Respondents and their experience

To the questionnaires for partner users answered 9 respondents and to the questionnaires for end-users answered 14 respondents. In total there were 23 respondents or 22 respondents because one of the respondents solved both questionnaires. While the age groups of partner users were scattered, the end-users dominated in the group from 26 to 35 years in addition to three respondents in age group from 46 to 55 years and two respondents in the age group up to 25 years.

Partner users have different roles on the project and different experiences working on projects funded by the European Community: from 0 to 15 years, or cooperation on from 0 to more than 20 projects. Closely related to that are positive and negative experiences about participating in projects and with project websites. End-users are employed in educational institutions and commercial companies and have also

participated in several projects. One of the end-users stated that he / she is currently unemployed.

Among the positive experiences the partner users exposed interactivity and online learning on the project website, teamwork by using GoogleDocs and in particular that the project offered useful information about the project and connections with the project that benefit in personal and professional development. End-users stated as positive experiences the availability of contacts, applicability and usefulness of project results, publicly available materials, publications and products of the project, monitoring of project process, news, and interactive and informal way of learning.

Among the negative experiences the partner users reported that it was not possible to influence on project website and project's final product, that more was promised that actually done, the inconsistency of content among different languages, lack of updating content and outdated content, not optimized (too long) texts about the project, poor project management, unpredictable events on the project, changing work instructions, and that the final project products were not useful in praxis. Negative experiences of end-users were similar: not updated content after project ended (since project did not provide the integration of the results into the business process), excessive complexity of the project making it difficult to control information, and inadequacy of the amount of information. One respondent stated also no seriousness of the project organizer and country toward the participants.

Objective, message and purpose of website

Primary website message and secondary objectives should coincide with expectations of end-users as much as possible. Partner users identified as primary message the promotion of the project, i.e. that is publicly known that project exists and what is the purpose of the project, but mainly they highlighted that primary message should be the useful value of the project. As a useful practical value they mentioned the benefit of the nature (nature-friendly work and life and nature-friendly sustainable development) and human well-being (improvement of knowledge and skills, namely qualifications of individuals which can lead to green careers and entrepreneurship opportunities in the field of chemical engineering). As the primary message someone also stated the awareness of the possibility of networking with other partners, organizations and individuals. Secondary objectives were expected to be similar to primary message or they will expand it. The focus was on the well-being of nature and people through informing and raising awareness of the wider

population about environmental issues, prejudices and benefits of maintaining a healthy planet as much as possible, presenting a broader view on so called green economy, green chemistry, green jobs, green skills and how they are connected with project objectives, and how individuals can obtain the desired professional qualifications according to information on the project website. In addition to secondary objectives were given also the products that are planned within the project: multilingual online platform for presentation of project results, their evaluation and achieving sustainability of the project, a place for gathering feedbacks and ideas for improvements of information and project products from the widest possible population, and observing the usability of products, and identifying potential partners for cooperation.

According to the partner users, the project stands out from other projects because of modernized treatment of green chemistry and positive opportunities for nature and people and that will, in connection with the tool for competence profiling, offer new content in the field of chemical engineering as lifelong learning, vocational training and university education through the implementation of education on additional competences and skills of the green chemistry. It can be concluded that the primary message of the website and secondary objectives are particular the well-being of nature and people through treating the environmental topics related to green economy, green jobs and achieving qualifications in this field. As it will be written in the continuation, the end-users will accept and adopt the message and objectives if they see in them benefits for themselves.

Partner users see as website's targeted audience individuals and organizations. Individuals are people of 20 years and older, unemployed and students who would like to acquire new qualifications for future careers or entrepreneurship, eco-aware employees who want to teach others about green economy, green jobs and green chemistry engineering (e.g. teachers, trainers), who are already dealing with environmental issues in their company (e.g. renewable resources, energy-saving construction, transportation, pharmacy, etc.) and such wishing to introduce green jobs in their companies and organizations. Among the organizations are national and international organizations in the field of chemistry engineering who are acting as a bridge between education and economic sectors that often transmit requests for innovative approaches in their area.

With questionnaires reached public of end-users was different than expected; however, it is still a representative starting point for determining the content, organization of the content and functionality of project's website. The reason to use the website, as seen by the partner users, is mainly identical to primary message and secondary objectives. In addition it was emphasized that website will offer free information also of higher difficulty (it was not specifically stated what was meant by this) and innovative developing methodology for collecting green jobs and environmental management. As expected, the website for partner users represents communication to the public, dissemination of information and products (concrete content and interactive tools) and ensures the sustainability of the project.

Perception

Partner users have given addresses of 17 websites that were visually appealing and 12 websites that met the aspect of professionalism. 7 websites from second list coincided with the first list of websites. End-users gave 9 and 7 websites for the same questions, respectively. Reasons for likeliness and satisfaction of professionalism aspect are mainly due to colour consistency, modern appearance with simple organization of content and functional design (easy and quick access to important information without unnecessary information). Reasons of 9 websites that partner users did not like, and 7 that end-users did not like were mainly because of too much information (text), non-optimal organization, inadequate menu, not updated information and too slow performance. Especially interesting was one answer who reported the website of project VQTS-PH since that project is a foundation of the project STRENGTH.

Among the colours that partner users suggested, green and blue are the colours that mostly stand out, while they also propose the use of third brighter colour. End-users in addition to green and blue colour combination suggested also several different combinations which are probably related to the fact that they have not created an association of project STRENGTH with green jobs. According to the partner users website should avoid non-environmental colours and especially yellow. Avoiding yellow colour was proposed also by end-users, and also avoiding the green and some other colours. The biggest emphasis to emotions that website visitors should experience the partner users gave to expertise, innovation, functionality and entrepreneurship. Ecological feeling was placed in fifth place, and appearance related emotion on the sixth place. End-users have made identical top three most important

emotions, only the order was slightly different: innovative, functional and professional. Ecology was placed on fourth, while the entrepreneurship was places on seventh, eight and thirteenth place.

Website content, preparing content

Content that partner users expect on the website along usual content (score information about the project, objectives, partner consortium, resources and results) are: (score 4,9) document repository for participating in the project (score partners, subcontractors); (score 4,7) project related events; (score 4,6) publications in press; (score 4,5) FAQ - frequently asked questions and answers; (score 4,5) contact form; (score 4,5) search; (score 4,4) sign up for news notification; (score 4,0) news; (score 3,7) adding and reading comments about content; (score 3,7) button "send to a friend"; (score 3,6) forum for participating in the project (score partners, subcontractors); (score 3,3) grading content; (score 3,2) document repository for general public; (score 3,1) forum for general public; (score 3,0) photo gallery for participating in the project (score partners, subcontractors); (score 2,9) photo gallery for general public; (score 2,1) live chat.

End-users had a choice between larger set of content and elements of website, and gave the following scores: (score 4,82) basic / general information about the project; (score 4,73) news; (score 4,64) project objectives; (score 4,64) project results; (score 4,64) sign up for news notification; (score 4,64) e-learning content; (score 4,55) contact form; (score 4,45) expected project results; (score 4,36) impact of project on jobs; (score 4,36) document repository; (score 4,27) project phases; (score 4,18) project related events; (score 4,18) added value of project; (score 4,18) list of project partners; (score 4,09) FAQ - frequently asked questions and answers; (score 3,91) glossary of terms; (score 3,91) links to other important websites; (score 3,91) photo gallery; (score 3,73) adding and reading comments about content; (score 3,73) self-evaluation of competences; (score 3,73) necessity of project; (score 3,73) methodology of project; (score 3,73) historical reasons for project; (score 3,64) publications in press; (score 3,55) search; (score 3,27) grading content; (score 3,09) detailed description of partners; (score 3,00) button "send to a friend"; (score 2,64) forum; (score 2,64) live chat.

Among the proposals of the information that should always be displayed, partner users expressed their desire for the username (after login to the site), date and partner logos. From the design point of view, permanent display of partner logos is

questionable due to different colour schemes of logos and their impact on the overall colour scheme of project website. Additionally desired content on the project website by the end-users are sitemap, links to online social networks, publications, tools, work packages and the results of the packages. End-users further emphasized the desire for open access to educational content.

Basically partner users agreed that content in the languages of project partners is sufficient, although with having doubts at the expenses they suggested also French, German and Russian language. Exclusive for partner users should be the following content: entire website, a forum for partners, and almost all final content and tools for profiling competences. Some desires about restricting access and offering information to the general public are contradictory which makes it necessary that project partners come to consensus about that prior to making the project website.

Usage and promotion

Very distinct responses were about expected frequency of website visits: 5 to 6 visits per day, up to 100 visitors per day or in whole up to 500 (possibly different) website visitors for the duration of the project. The website will be efficient if it will manage to gain visitors and feedback information about the results, products and usefulness of the project, which is related to the number of different visitors of the website and frequency of revisits.

To promote the website, partner users will resort to the following: links from their websites to the project website; advertising the project in chambers of commerce, educational institutions, conferences, festivals, television and radio; advertising links on social networks; brochures; promotion in local universities, among colleagues, departments of chemistry on other universities, the national chemistry associations, international green websites, and promotion on the forums with similar topics.

The website will be optimized with keywords to achieve good ranking in web searchers lists. Additionally, the website will be entered into web searchers lists that allow entering. Suggested keywords are: green job, green chemistry, green economy, green competences, green skills, competence profiler, job profiler, ldv toi. Among all respondents is apparent awareness about using websites on mobile devices, therefore they propose that the website should be adapted for these devices.

Versions of project website

Project website went through 4 major versions involving all project partners, while the draft version before pilot version was prepared in coordination with project partner P3. During the project website evolved from pilot version (V1) to final version V4. Changes of project website were significant while preserving the design red line decided at pilot version. Most changes were due to improvement of information structure and incoming results of the project.

Pilot version (V1)

Pilot version which was introduced at second project meeting was prepared according to results of needs analysis and was located at www.greenstrength.eu. Questionnaire responses suggested organization of content and information on the project website is the following:

Organization of information on global level:

1. About ... general information

   (1) Necessity of project; (2) Aim; (3) Objectives; (4) Transfer of innovation; (5) Added value; (6) Methodology; (7) Project phases

2. Consortium

   (1) P0 University in Granada; (2) P1 Intellect Foundation; (3) P2 University in Sofia; (4) P3 University in Ljubljana; (5) P4 LKF Associates Ltd.

3. Model ... general information

   (1) Competence profile; (2) Competence matrix; (3) Competence profile certificate; (4) Mobility

4. Green jobs ... results regarding green jobs

5. Competence profiler ... usage of intelligent tool

6. Resources

   (1) Glossary; (2) Useful links; (3) FAQ; (4) Media / Press; (5) Internal documents

Website's first page is comprised from menu and several areas: Menu: Home, About, Consortium, Model, Green jobs, Competence profiler, Resources; Area 0

(project): logo, project title; Area 1 (basic info): basic info about project; Area 2 (main info): aim, objectives, chemical engineering, green jobs, intelligent tool, mobility process; Area 3 (consortium): list of project partners; Area 4 (news): news, all news; Area 5 (products): competence profiler; Area 6 (footer): Leonardo da Vinci Transfer of Innovation project, useful links; Area 7 (follow the project): social networks, RSS; Area 8 (additional website info): search, partner languages, sitemap, legal notice; and Area 9 (additional functionality): registration, login.

Some areas contain other areas, the text must be everywhere minimal and covering only the essence (the primary message, secondary objectives and access to vital information and tools). On each web page should be the menu, areas 0, 6 and 8, username and the date. The possibility of commenting the content and access to tool for competency profiling is enabled only after prior login to the website. For the tool or interface for the preparation of the content there were no specific expectations, just the usual: the possibility of changing the content, undo button and adding comments to important topics. If any assistance will be needed about preparing the content, support by e-mail is sufficient and it is expected not to be immediate. For visitors, according to the partner users, at first visit of the project website the most important will be the first page with emphasized useful practical value of the project, project objectives, who are the partners, what are educational content and an attractive short video on first page. Visitors will be coming back to website because of the competence profiling tool, active learning, news, results, uploaded documents, reports and content that can be utilized for green jobs. The responses indicate different understanding and expectations of the results and products of the project among the respondents. End-users provided similar responses, they are interested in purpose, project objectives, who are the partners and what will be the results, how much the project is theoretical and how much practical, and above all what is the useful value of the project in praxis, what individual obtains from the project and what is the content of lifelong learning. For revisit reasons they stated similar reasons as partner users and mainly to obtain new information. Pilot version is shown in Figure 1.

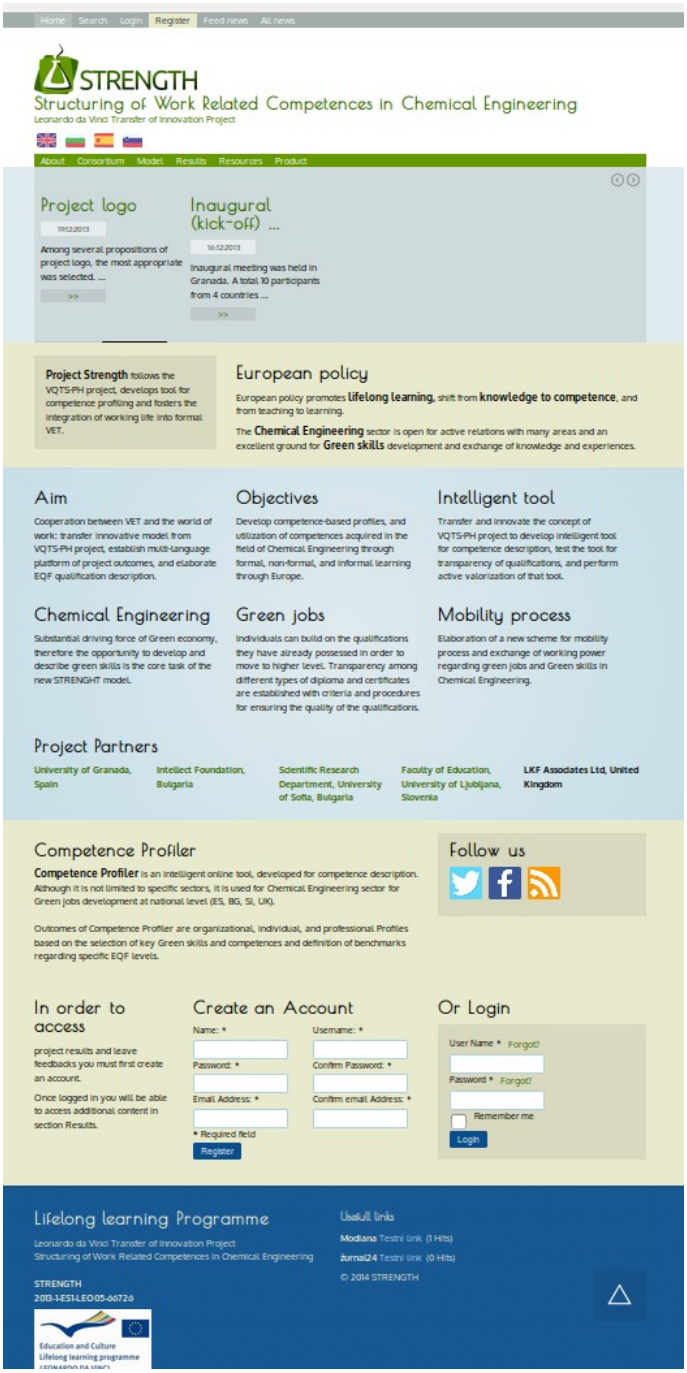

Figure 1. Pilot version of project website

Version V2

Version V2 contained changes based on comments about pilot version. Mainly these comments were about changing structure of information to reflect structure of project brochure. Before that structure was prepared based on initial project information and the project from which project STRENGTH was transferred.

Version V3

Version V3 was next evolutionary step of project web-site. It considered comments from version V2, new information and products produced from V1 to V3 and included competence profiler. Competence profiler is external tool having front-end engine and style definition and can be embedded into arbitrary website.

Final version V4

Final version V4 was introduced after final project meeting and took into account final remarks and change of structure according to project results and added value of the project. In addition, competence profiler got additional functionality which also reflects at the project website. For a short period, project website was also connected to auxiliary website hosting project STRENGTH conference (http://conference.greenstrength.eu). Figure 2 shows the final project website.

Figure 2. Final version of project website

Maintenance and usage

Project website was hosted on dedicated hardware server providing enough power, communication capacity and data storage. All data related to project website was regularly saved to external data storage. Since October 2014 all access and usage of website was monitored and logged into server log. Partner P3 was main content manager while all partners have user account for self managing the information on project website.

The expectations of partner users were considering the specifics of the project (chemical engineering, specific area of interested professionals and interested public, relatively short timeslot when project website was introduced to public to the end of the project, continuous addition of results, etc.) and having at least 500 different users during the project duration will be considered as success. Data mining through web server log with the tool Dashboard showed that this expectation was met and significantly exceeded. From October 2014 to September 2015 project website visited more than 5.900 visitors, on average 16 visitors per day, Similar statistics, project website gained more than 160.000 total page views. For specific project website as was this, these numbers are success. Number of visitors and related network traffic increased when new results were published, project partner promoted the website and when project partners conducted workshops and testing activities. Significant amount of mobile users proved that future websites have to be ready for mobile devices - project website implemented responsive design at pilot version and improved it each version. Web server log reported also data collection activities and inclusion of project website into major search engines.

Conclusions

Nowadays, websites are part of our everyday life and it was a long time ago when they exceeded only presentation of information from paper to the web. Developing a website and especially the project website is one of the best ways to provide information to people. Project websites can be important integral part of project results. Therefore it is important to carefully design it, prepare the right content in suitable amount of information and especially to offer end-users what they need. It is a challenge to create a website that is easy, efficient, attractive and intuitive to those who use it. Namely, more than billions websites exist and it is not our intention to create just one website in the sea of websites.

Project STRENGTH website was designed and implemented according to needs analysis, constructive comments from project partners and production of the results during the project time. The most important lessons learned are that concepts of importance of "green", proper "green" treatment, and concept of project websites are closely related to the concept of "commercial website". The project website proved the intuitive thinking about the project website - the most important are the results of the project, how user identified with them and what benefit they, nature or economy can have from them. Actually, project websites are very similar to commercial product websites only that they have different commercial note or don't have it as in our case.

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2. Green jobs

GREEN STRENGTH SUSTAINABILITY: A CASE STUDY OF CHEMICAL ENGINEERING STUDENTS

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Abstract

Green chemistry is a relatively new area of science and technology aimed at improving chemical processes and thereby avoiding negative impacts on human health, safety, and the environment (EHS). It is based on careful selection of raw materials for the production of various products, excluding the use of hazardous substances. The field of green chemistry has received much attention from the scientific and industrial communities in almost every highly industrialized nation. It is understandable that the principles of green chemistry should generate strong interest in countries or regions with high production capacities. Unfortunately, that industry resulted in a number of highly contaminated sites, hazardous and resource consuming production tools. A strong industrial development in European Union (EU) countries took place in last two decades focused on a profit, when there was small or no concern about some specific environmental issues. Human health and safety was rather controlled with robust standards. Environmental, health and safety protection remain a major component of co-operative activities between EU and other world. In particular, management of environmental risks associated with man-made changes, industrial, agricultural and military wastes, including risks for soil, water, air and the food chain and possible remediation are identified as one of the three priorities of the EU "Specific measures in support of international co-operation" program. These are challenges that need to be faced worldwide. With that respect, Green Chemistry is a promising approach to pollution prevention because it applies innovative scientific solutions to real world environmental situations. Green sustainability has started from educational and training institutions on entire vertical of education. In our research, we investigated chemical engineering freshman and senior students considering their perception toward importance of EHS area and about self-reported level of green competencies achievement during study. Freshman and senior students of chemical engineering estimated importance of green competencies as highly desirable. Existing curriculum in chemical engineering allows students achievements at basic level, while for high level of

green chemistry; curriculum upgrade / modification is needed. It was judged that proposed green chemistry courses show potential for implementation and use at competitive higher education and training.

Keywords: chemical engineering, green abilities, environmental health and safety, sustainability

Introduction

Green chemistry formed as an area of research in the late 1990s. Over the past 15-20 years, it has become a leading scientific paradigm underlying the development of modern industrial production [1]. The corresponding technologies, processes, and products are introduced not only in the chemical industry but also in other industries that use chemicals, for example, in the agricultural, textile and food industries. Companies such as Armani, Adidas, Nike, Puma, and Levi Strauss & Co. can serve as an example of the use of the principles of green chemistry in the production of clothing. They have all pledged to lead the industry to zero discharge of hazardous chemicals by 2020 [2]. Despite a significant growth in the rates of introduction of green chemical technologies and products in last decade, this trend is regarded as not enough developed in EU countries industry.

In 2013 the European Federation of Chemical Engineering celebrated sixty years of the chemical industry development and establishment of the corresponding academic discipline in the Universities and University Departments closely related to that industry. The last sixty years have seen enormous developments in the chemical industry and the discipline of chemical engineering and it is obvious that Europe has had an important role to play in these developments.

Chemical engineering, as an academic discipline, involves the design and management of biological, chemical and physical processes that enable raw materials to be converted into valuable products. It is a discipline that is based on scientific knowledge from chemistry, physics, biology and mathematics combined with engineering principles. Chemical engineers design both products and the processes and manage their operation and optimization in order to ensure safe, that they are economically viable and environmentally acceptable. On the other hand, the processes that are managed, as a part of the designed plant, include biological and / or chemical reactions in a sequence that provides minimal loss of materials and

consumption of energy. The same unit operations are equally applicable across industries such as petroleum / petrochemical industry, food processing, mining and related industries, production of plastics and chemicals, pharmaceuticals production, environmental management, and biotechnology where, in some cases, additional skills of the chemical engineer are needed. It is important to note that Chemical Engineers must be capable of reacting to any change in production conditions and partly because the Chemical Engineering is closely related to discoveries in the enabling sciences of the profession such as biology, chemistry, biochemistry, microbiology and physics. Hence, the chemical engineer must be familiar with the language and principles of these sciences (at least to acquire additional specific skills) and / or to be able to work closely with specialists from these fields and other fields of engineering, management and industrial relations.

Therefore, training of specialists who would have a responsible attitude to the country is a focal issue for EU. If today's students and postgraduates - chemists, chemical engineers - deeply realize that we do not and will never have another Earth, if they get to know the existing opportunities and already implemented developments in green chemistry, there is hope that they will further evolve this area of science and consecutively strive for minimization of environmental, health and safety damage from operation of industrial enterprises. Hence, there would be a chance that our next generations will live under tolerable life conditions and be relatively healthy.

Against this background, the questions explored in our study are:

1. Does a new synthesized area of green competences, entitled Environmental, health and safety, enhance students' motivation toward perspectives of green jobs?
2. What is the perceived and self-assessed current level of green competences?

Green Chemistry and Jobs

The chemicals industry and other related industries supply us with a huge variety of essential products to everyday living. However, these industries have the potential to seriously damage our environment. In the last decade, the scientific community has witnessed a growing interest in environmental issues and the value of environmentally friendly energy generation and chemical processes. The combination of chemical engineering tools with the findings of green chemists, biologists, and

environmental scientists has allowed the design of new processes for the manufacture of chemicals, fuels, and products with a much reduced environmental footprint. Furthermore, the developed environmentally benign alternative technologies of green chemistry have been proven to be economically superior and function as well as or better than more toxic traditional options [3].

Green Chemistry can be defined as the "design of chemical products and processes to reduce or eliminate the use and generation of hazardous substances" and illustrates the 12 principles of Green Chemistry, a set of "design rules" which illustrate that field, announced by Anastas and Warner [4]:

1. **Prevention:** It is better to prevent waste than to treat or clean up waste after it has been created.
2. **Atom economy:** Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. **Less hazardous chemical syntheses:** Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. **Designing safer chemicals:** Chemical products should be designed to affect their desired function while minimizing their toxicity.
5. **Safer solvents and auxiliaries:** The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.
6. **Design for energy efficiency:** Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.
7. **Use of renewable feedstock:** A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
8. **Reduce derivatives:** Unnecessary derivatisation (use of blocking groups, protection / deprotection, and temporary modification of physical / chemical

processes) should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.

9. **Catalysis:** Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. **Design for degradation:** Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.
11. **Real-time analysis for pollution prevention:** Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. **Inherently safer chemistry for accident prevention:** Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.

The challenge of green chemistry for both academics and industrialists is to devise sustainable strategies that meet the demand for chemical products from an ever-increasing population. Green chemistry addresses the following aspects of manufacturing [5]:

1. Working through the arc of an industrial process, the first challenge is to identify renewable feed stocks. The current front-runners are non-food plants, in which case chemists must find effective ways of converting the whole plant into useful products.
2. The reactions involved in making chemical products must be devised to minimize environmental impact. For example, many raditional catalysts are based on metals, which can be toxic or scarce; nonmetallic catalysts must therefore be developed, perhaps based on organic compounds (organocatalysts) or on enzymes that have been modified to perform useful reactions.
3. Engineering is also crucial - industrial processes and reactors must be designed to maximize efficiency and reduce waste. Improved analytical techniques are necessary to monitor the fate of potentially harmful chemicals in reactions and in the environment.

4. The impact of chemicals on the environment can be reduced by finding replacements with reduced toxicity and increased biodegradability compared with existing mass-produced compounds.

Talking about green principles and bearing in mind the "engineering" part of Chemical Engineering, it would be of great importance to present the 12 Principles of Green Engineering elaborated by Anastas and Zimmerman [6]:

1. **Inherent Rather Than Circumstantial:** Designers need to strive to ensure that all materials and energy inputs and outputs are as inherently non-hazardous as possible.
2. **Prevention Instead of Treatment:** It is better to prevent waste than to treat or clean up waste after it is formed.
3. **Design for Separation:** Separation and purification operations should be designed to minimize energy consumption and materials use.
4. **Maximize Efficiency:** Products, processes, and systems should be designed to maximize mass, energy, space, and time efficiency.
5. **Output-Pulled Versus Input-Pushed:** Products, processes, and systems should be "output pulled" rather than "input pushed" through the use of energy and materials.
6. **Conserve Complexity:** Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse, or beneficial disposition.
7. **Durability Rather Than Immortality:** Targeted durability, not immortality, should be a design goal.
8. **Meet Need, Minimize Excess:** Design for unnecessary capacity or capability (e.g., "one size fits all") solutions should be considered a design flaw.
9. **Minimize Material Diversity:** Material diversity in multicomponent products should be minimized to promote disassembly and value retention.
10. **Integrate Material and Energy Flows:** Design of products, processes, and systems must include integration and interconnectivity with available energy and materials flows.

11. **Design for Commercial "Afterlife":** Products, processes, and systems should be designed for performance in a commercial "afterlife."
12. **Renewable Rather Than Depleting:** Material and energy inputs should be renewable rather than depleting.

Chemical Engineers will play an essential role as designers and managers of hundreds of different products, processes and production systems which are currently or might be in the future the base of the welfare state. Green Engineering aims at transforming traditional Chemical Engineering practices into a more practices. Green Engineering feeds on a wide variety of disciplines and theories, it is of crucial importance to identify the needs for an specific applying the correct approach to the general design philosophy, to safety, to the chemistry, to the product and to the process and to the auxiliary facilities. The continuous adaptation of green engineering is the very base of sustainability in the chemical and process industry and that is the main reason to feed on all these disciplines argued by [7]. Principles of green engineering cannot be static, because environment, society and economy are dynamic. Therefore, Chemical Engineers are called to identify, assimilate and study the way in which these disciplines can be included within the design criteria to achieve sustainable solutions [7].

Finally, it must be highlighted that education and training in green engineering is the key weapon to tackle the current needs. Green engineering has to be introduced at academic and industrial levels to create a critical mass of engineers and scientists to undertake this challenge as soon as possible [7].

It is clear that Green Engineering is the development and commercialization of industrial processes that are economically feasible and reduce the risk to human health and the environment. All the above principles should be taken into account when determining the details of the project STRENGTH Competences Matrix.

Environmental health and safety area courses development

The green transition will require the development of a better understanding of the implications of green jobs on health and safety at the workplace. On the one hand, measures aimed at environmentally friendly workplaces can help to improve working environments, having a positive impact on workers' safety and health. In order to

shape the future of occupational safety and health in green jobs and inform EU decision makers, Member States' Governments, trade unions and employers, the European Agency for Safety and Health at work carried out research about the new and emerging risks associated with green technologies by 2020. Considering this research, the Leonardo da VINCI TOI Project STRENGTH (Structuring of Work Related Competences in Chemical Engineering), 2013-1-ES1-LEO05-66726, developed green matrix of key green competencies areas for chemical engineering, namely: agriculture; biotechnology; environmental, health and safety; food science, and pharmacy.

As the most important area, the environmental, health and safety (EHS), was detected. Several health and safety aspects were detected which could decrease green economy benefits and scale: a) Potential for exposure to unknown hazards from new processes and materials, b) Substitution of chemicals for environmental reasons could result in greater risks to workers, c) Chemicals obtained from renewable sources can still be toxic, and d) Potential risks at the recycling stage.

Environmental Health and Safety considers environmental protection, occupational health and safety. Its general objectives comprise prevention of incidents or accidents that might result from abnormal operating conditions at manufacturing facilities on the one hand, and reduction of adverse effects on the environment and human health that result from normal operating conditions on the other hand [8]. Its core value is to improve safety and health at work place, to support the continuous education and training of employers and employees in a defined area of economic activity, and to work cooperatively with regulating authorities to ensure the safety and health for all workers and for the environment [9].

The research mission of this branch is to provide fundamental information regarding actions on several major topic areas: Risk management & insurance, Fire & life safety, Physical safety, Chemical safety, Biological safety, Radiation safety, Ergonomics, Hazardous waste management, Environmental protection, Emergency response, Indoor air quality, Security for safety professionals, Occupational health programs, Communicating through the mass media. Most of the issues listed above are typically multi-faceted, thus commonly their research areas are overlapping. Nevertheless, their common goal is to characterize the interface between human health and environment through a set of tools and methods that identify, quantify and / or categorize exposure and thus to prevent, and control factors that can damage both human health and the environment [10].

EHS raises fundamental awareness in Chemical Engineers and ability to adequately handle specific inquiries and problems. This means to develop, plan, implement and review activities to achieve end-user satisfaction, zero accident, safe workplace and business sustainability employing Chemical-Engineering-based knowledge. Environmental, Health and Safe postgraduate programmes are designed to provide a broad theoretical and practical education for Chemical Engineers who desire green profile positions in academic, industrial or government laboratories with an emphasis on managing environmental impacts and Health & Safety. The programmes are designed for those who are seeking to update their current knowledge adopting green skills and to enhance their career opportunities in specific areas such as occupational safety and health, environmental management, fire safety, food safety the built environment and risk management. Advanced professional education for those Chemical Engineers who desire leadership positions in EHS practice, policy analysis, professional communication, programme management, high-level administration, and / or decision-making in an environmental health and safety setting is offered by the Master and PhD programmes in this occupational field.

Professional realization is anticipated within occupations like Environmental, Health & Safety Specialist; Environmental Health & Safety Manager; like Environmental, Health & Safety Coordinator; health and safety analyst, Health and Safety consultant. Employment is expected as well within manufacturing, technology, public and private sectors, chemical, environmental and associated industries in a variety of health, hygiene, safety, fire, food, quality, regulatory, consultancy and related roles [11].

By mapping existing competencies in industry, STRENGTH developed 10 courses in EHS area aimed for vocational education and training at national and international level using mobility scheme procedures. Courses allow systematically development of three main cognitive components: knowledge, skills and wider competences of critical thinking and decision-making by considering the European qualification framework (EQF) [12], and credits system (ECVET) [13] for vocational education and training at EQF level 6 and 7. All ten courses comprise together of 34 European Credits (EC) and allow achievements described with 19 competences for knowledge component, and 14 skill competencies which are condensed in 8 green abilities. All cognitive structures could be obtained both at level 6 and 7 of EQF.

Project STRENGTH matrix area of EHS consists of the following courses:

1. BIOSAFETY. This course provides information about protection of laboratory workers, the environment, and the community from exposure to bio-hazardous materials while protecting the integrity of experimental material. It presents the rules to perform research involving biological agents in a safe and responsible manner, and in compliance with applicable regulations and policies. This course gives as well the basis for the application of combinations of laboratory practice and procedure, laboratory facilities, and safety equipment when working with potentially infectious microorganisms to minimize the risk of transmission of disease and / or release to the environment (3 EC).

2. CHEMICAL SAFETY. The course covers the main topics in safe handling of chemicals in the lab. It provides resources on how to monitor that all unwanted chemicals are disposed of in an environmentally friendly manner and in compliance with national / international environmental regulations; how to communicate the potential hazards which are present when handling hazardous chemicals and to describe the proper methods of collecting Hazardous (Chemical) Waste, thus reducing the number of chemically related occupational illnesses and injuries, and protecting the environment (3 EC).

3. EMPLOYEE / OCCUPATIONAL SAFETY. The course presents information about providing a safe working environmental for all reducing risks to the personnel with emphasis on personal responsibility and environmentally sound management. It describes the importance of using safe work practices while carrying out the responsibilities of employees' jobs. It stresses as well on the management's primary responsibility for ensuring a safe working environment (4 EC).

4. FIRE SAFETY. The overall goal of the course is to present information about all aspects of fire safety, namely the protection of life and property from fire. It aims to identify and minimize those conditions and / or actions that may encourage fires to start and spread. Trainees are educated on fire safe practices, on how to conduct fire safety inspections, to prepare and implement evacuation plans; to maintain a database of fire safety compliance and incident information (3 EC).

5. LABORATORY SAFETY & HAZARDOUS WASTE. This course covers all current regulatory issues regarding proper chemical handling procedures, including

requests for chemical pickup, labelling and signage, how to clean out a lab, and how to handle a hazard emergency. It also presents key elements of a Chemical Hygiene Plan and laboratory safety. Special emphasis is paid to the so called Controlled Substances - drugs or substances controlled for research use only, and the legislative basis for their exploitation. The course provides essential information specifically for those working in medical, biological and life sciences research laboratories that contain hazardous biological materials. It is designed to ensure compliance with the regulatory requirements applicable to those laboratory research activities (4 EC).

6. INDUSTRIAL HYGIENE. The course is focused on provision of expertise and advisory services for assessing the daily hazards encountered in the work place and the research laboratory. It describes the development of procedures and controls (engineering controls and personal protective equipment) that minimize the adverse impact of working with hazardous substances. It also postulates the principles of determining the nature and amount of exposure and compare this information to Occupational Safety and Health regulatory limits and recommended standards (4 EC).

7. RADIATION SAFETY. Radiation Safety course includes an introduction to the science and technology of ionizing radiation in terms of: sources, fundamentals of measurement, bioeffects, regulations, Good work practices, and accident recovery. It also discusses topics related to control of radioactive materials and radiation producing devices is consistency with national / international regulations and recommendations (3 EC).

8. GENERAL SAFETY, INJURY PREVENTION & EMERGENCY PREPAREDNESS. The course covers practices and procedures for preventing employee injury or illness from potential workplace hazards. Information is provided on emergency kits, family preparedness plans, fire safety, earthquake preparedness and more (3 EC).

9. LABORATORY AUDIT PROGRAM. The course describes the basic steps in conducting safety audits of laboratories in terms of providing people with a safe working environment and encouraging them to operate in an environmentally friendly manner. The course is designed to provide information and tools necessary to conduct a research safely, to protect the environment, and to meet regulatory requirements (3 EC).

10. GLOBAL ENVIRONMENTAL MANAGEMENT SYSTEM: ISO 14001 STANDARD. The course presents the fundamentals of the voluntary international standard ISO 14001 as a tool establishing the requirements for an environmental management system (EMS). The main objective of the standard: organization to establish an EMS that is integrated with the overall business management process is explained. The basic elements of the EMS - Environmental Policy, Planning, Implementation and Operation, Checking, and Management Review are discussed. The concept of continual improvement of the EMS (such as improved communications and employee awareness, improved environmental performance, and improved emergency planning and response programs) as an integral part to the standard evolution is introduced (3 EC).

Methodology

Importance of green competences and skills was assessed by surveying chemical engineering freshman students and their senior-level counterparts. Beside this, students' achievements in chemical engineering were contrasted with their self-assessment of green competencies obtained during the study.

Sample

The sample for study was drawn from chemical engineering students at Cracow University of Technology, Cracow, Poland. Group of freshman engineering students consists of 30 students while the senior-level counterparts were of 31 students. The university recruited in this study was selected by role models (university scientist, applied science researchers, or young researchers) in order to explore of possibilities of project STRENGTH results exploitation. Groups of students recruited in this study had similar demographic in gender, but different in age. Paper and pencil survey was distributed accordingly. The participants' genders were not evenly distributed: 72.1% (nF = 44) females and 27.9% (nM = 17) males. Freshman students were aged 19 ± 1 year while seniors were aged 23 ± 1 year.

Instrument

Student experiences, and perceived competence importance were considered important for the long-term success of STRENGTH courses. For this purpose, a researcher-developed questionnaire addressing the specifics of the course offerings was administered to the students. The survey items were validated by an expert panel.

The expert content validators were university professors and chemical engineering experts. An expert panel provided evidence of survey content validity. The survey consists of the 41-item survey divided into three subscales. The knowledge subscale was surveyed with nineteen items, the subscale of skills with fourteen, and green abilities with eight items. For the assessment, a 6-point phrase completion scale was used as recommended by Hodge and Gillespie [14]. The scale intervals form a continuous type from minimum (0) to maximum (5). The scale does not present the mean, but ensures the comparability of continuous responses and produces better assumptions of parametric statistics while avoiding bias [14].

Procedure and data analysis

The survey is designed to assess general attitude toward green competencies. The data is collected in Cracow when students attended residential workshops in January 2015. Students were instructed to read the competences, try to think about what they generally feel about the Importance of competence, and also circle the number (0-5) that best represents their current green knowledge, skills and abilities (Current level). Procedure took about 10-15 minutes to complete the survey. Students were warned that do not spend too much time on any item and indicate their immediate feeling and move on to the next item. High response rate was obtained by direct presence of lecturers / instructors and survey administration.

Data analysis was conducted using SPSS 22. Descriptive analyses were conducted to present the student basic information, the mean score of predictor variable, and of student self-assesed level of competence mastering. Cronbach alpha as a measure of internal consistency was calculated for entire survey, and at its subscales. The Levene's test for equality of variances was used. A Multivariate analysis was conducted to find and confirm significant relationships between groups with an effect size. The measure of the effect size is eta squared.

Results

Reliability

Internal consistency coefficients (Cronbach alpha) for two main green readiness scales and their subscales are presented in Table 1.

Table 1. Internal consistency of green readiness scales (n=61)

Scale	Knowledge	Skills	Green abilities	Total
Importance	0.86	0.91	0.85	0.94
Current level	0.91	0.95	0.87	0.96

As shown, the alphas across the scales ranged between values of 0.85 to 0.96. Cronbach's alpha scores above 0.9 are considered as strongly reliable and highly adequate for research applications [15].

Descriptive statistics and variance analysis

The Levene's test confirmed that the study sample did not violate the assumption of normality, which confirmed that the sample is normally distributed ($p>.05$).

Multivariate analysis of variance revealed significant difference in perception of green knowledge importance. Both groups had estimated importance of green knowledge as high, nevertheless, seniors prevailed at item of KN5, KN6, KN18 ($p<0.05$) with moderate effect size (eta squared = 0.1). Self-assesed green knowledge is significantly higher at seniors at almost all items. Effect size is regarded as high (eta squared>0.14) [15].

The means and SDs for each of the survey item according to the survey subscales are presented in Table 2 and 3.

Table 2. Descriptives of knowledge competences' importance and self-assesed current level of freshmen and senior students

Knowledge (KN)		Importance				Current level			
		Fresh.		Senior		Fresh.		Senior	
		M	SD	M	SD	M	SD	M	SD
KN1	Apply fundamentals of chemical composition, structure, and properties of substances	3.9	0.8	4.1	0.8	3.3.	0.9	3.9	1.1
KN2	Use basic rules of calculus and statistics	3.3	1	3.8	1.2	2.8	0.8	3.5	0.9
KN3	Describe data related with plant and animal organisms, their tissues and cells	3.3	0.9	3.4	1.3	3.2	0.9	3.3	0.9
KN4	Apply engineering science and technology practical principles	4	0.8	4.2	1	2.3	0.9	3.7	0.8
KN5	Differentiate sources of pollution and determine their effects on the	3.8	1	4.5	0.8	2.8	1.1	3.9	0.9

	environment								
KN6	Define hazardous communication and hazardous waste operations	3.9	0.9	4.4	0.9	2.2	0.9	3.6	0.9
KN7	Advise on environmental, safety and industrial hygiene regulatory requirements and best practices; lead job hazard evaluations and industrial hygiene surveys to assess employee health and safety risks and develop and implement appropriate improvement plans	3.6	0.8	3.9	0.8	1.9	1.3	3.2	1.2
KN8	Evaluate and manage environmental, social and health impacts.	3.8	0.8	3.9	0.9	2.7	1.1	3.3	1
KN9	Maintain an in-depth knowledge of applicable regulatory requirements	3.7	1	3.1	1.3	2	1.3	2.4	1.3
KN10	Enforce environmental, health and safety standards	4.1	0.8	3.9	1.2	2.4	1.1	2.8	1.2
KN11	Perform emergency / crisis management in terms of planning and response, including incident investigation to ensure thorough root-cause analysis and comprehensive corrective action	4.3	0.7	4.0	1.1	2.5	1.3	2.9	1.1
KN12	Anticipate, identify and evaluate hazardous conditions and practices	4.1	0.7	4.3	0.9	2.7	0.9	3.3	1.1
KN13	Develop hazard control designs, methods, procedures and programs; implement and maintain plant-level EHS regulatory compliance and training programs	3.5	0.9	3.4	1.3	1.8	1.1	2.7	1.1
KN14	Implement, administer and advise others on hazard control programs	3.3	0.9	3.4	1.2	1.5	1.1	2.2	1.4
KN15	Draft a future safety plan and statement based on real time experiences and facts	3.8	0.8	3.7	1.3	1.8	1.3	2.4	1.4
KN16	Develop, implement and lead best-practice safety and environmental programs to drive pollution prevention, risk prevention and continuous improvement	4.1	0.9	3.6	1.2	2.1	1.1	2.6	1.3
KN17	Maintain EHS Management Systems, including ISO 14001 registration	3.1	1	3.4	1.3	0.9	0.8	2.0	1.8
KN18	Administer Process Safety Management (PSM) and Risk Management Planning (RMP)	2.7	0.8	3.1	1.1	1.1	1.1	1.8	1.3

	programs, including Process Hazard Analysis, Pre-startup Safety Review and Management of Change								
KN19	Coordinate permitting of manufacturing processes and manage follow-up permit compliance	3.6	0.9	3.5	0.9	1.2	0.9	2.3	1.4

Table 3. Descriptives of skills' and green abilities importance and self-assesed current level.

Skills (SK)		Importance (%)				Current level (%)			
		Fresh.		Senior		Fresh.		Senior	
		M	SD	M	SD	M	SD	M	SD
SK1	Synthesize, analyse, manage, and report environmental data (pollution emission measurements, atmospheric monitoring, meteorological / mineralogical information processing, etc.)	3.8	1	4.2	0.8	1.5	1.4	3.6	0.9
SK2	Conduct exposure assessments and monitoring; emissions modelling for air, waste or water	3.7	0.8	3.9	1.0	1.7	1.1	3.0	1
SK3	Perform studies to estimate and reduce emissions	4.2	0.7	4.4	0.7	2	1.3	3.5	1.2
SK4	Perform studies to estimate and handle radiation risk	4.3	0.8	4.2	0.8	1.7	1.1	2.4	1.4
SK5	Assess risks of bio-hazardous materials improper manipulation	4.2	0.7	4.3	0.8	1.8	1.2	2.8	1.3
SK6	Remediate contaminated sites	3.7	0.9	4.2	0.9	1.5	1.3	2.8	1.4
SK7	Asses control technologies and conduct safety inspections and audits	3.5	0.8	3.7	1.3	1.2	1.1	2.9	1.4
SK8	Develop environmental and safety procedures and guidelines	3.5	0.8	3.8	1.2	1.5	1.3	3.0	1.3
SK9	Determine data collection methods to be employed in research projects or surveys	3.6	1	3.5	1.2	2	1.2	3.1	1.3
SK10	Prepare charts or graphs from data samples, providing information on the environmental relevance of the data	2.8	1.2	3.4	1.1	1.9	1.1	3.5	1.4
SK11	Measure, audit and evaluate the effectiveness of hazard control programs	3.5	1.1	3.7	1.1	1.6	1.4	3	1.3
SK12	Establish and maintain all required records applicable to safety and environmental compliance of the site	3.7	1	3.7	1.2	1.7	1.1	3.1	1.3
SK13	Collect, analyse and track performance KPIs for continuous improvement and Corporate reporting	3.5	1	3.5	1	1.5	1.1	2.6	1.2
SK14	Drive fulfilment of institutions' Environmental,	3.7	0.9	3.0	1.2	1.1	1.1	2.1	1.4

	Health and Safety policy to foster and maintain a strong and effective EHS culture								
Green abilities (GA)									
GA1	Fundamentals of chemical composition, structure, and properties of substances application.	4.1	0.9	4.2	0.8	2.6	1.1	4.2	0.8
GA2	Use of basic rules of arithmetic, algebra, geometry, calculus and statistics.	3.5	1.1	4.2	0.9	3	1	3.7	0.9
GA3	Application of engineering science and technology practical principles, and living organisms' structure and functions.	3.8	1.1	4.1	0.8	2.7	1	3.3	1
GA4	Specification of sources of pollution, determination of their harmful effects on the environment; performance of hazardous waste treatment operations; administer and advise on hazard control programs.	4.1	1	4.1	0.9	2.8	0.8	3.6	0.9
GA5	Maintenance of an in-depth knowledge and implementation of environmental, safety and industrial hygiene regulatory requirements and best practices.	3.6	1	3.7	0.9	1.6	0.8	3	1.2
GA6	Evaluation and management of environmental, social and health impacts.	3.7	1.0	3.6	0.9	1.9	1.2	2.8	1.3
GA7	Carrying on safety inspections and audits and enforcement of environmental, health and safety standards including ISO 14001.	3.4	0.5	3.9	0.9	1.3	1	3.1	1.4
GA8	Performance of emergency / crisis management in terms of planning and response.	4	0.8	4.2	0.7	2.3	1.1	3.3	1.2

Importance of skills and green abilities was estimated very high at both groups of students. Seniors estimated importance significantly higher ($p<0.05$) at survey item of SK1, SK6, and SK10, while freshmen stressed importance significantly different at SK14. Effect size is moderate (eta squared=0.5-0.8). Importance of green abilities is demonstrated as highly desirable by both groups (Figure 1), while seniors stressed more influence at GA2 and GA7 ($p<0.05$, eta squared=0.11). Considering the gender, there is a significant difference ($p<0.05$) of perceived importance at GA2 and GA3 where male students expressed that using math tools in green chemistry (GA2) and practical implications of science and technology (GA3) have an important role at design and engineering of new products. Effect size is regarded as moderate (eta squared=0.06).

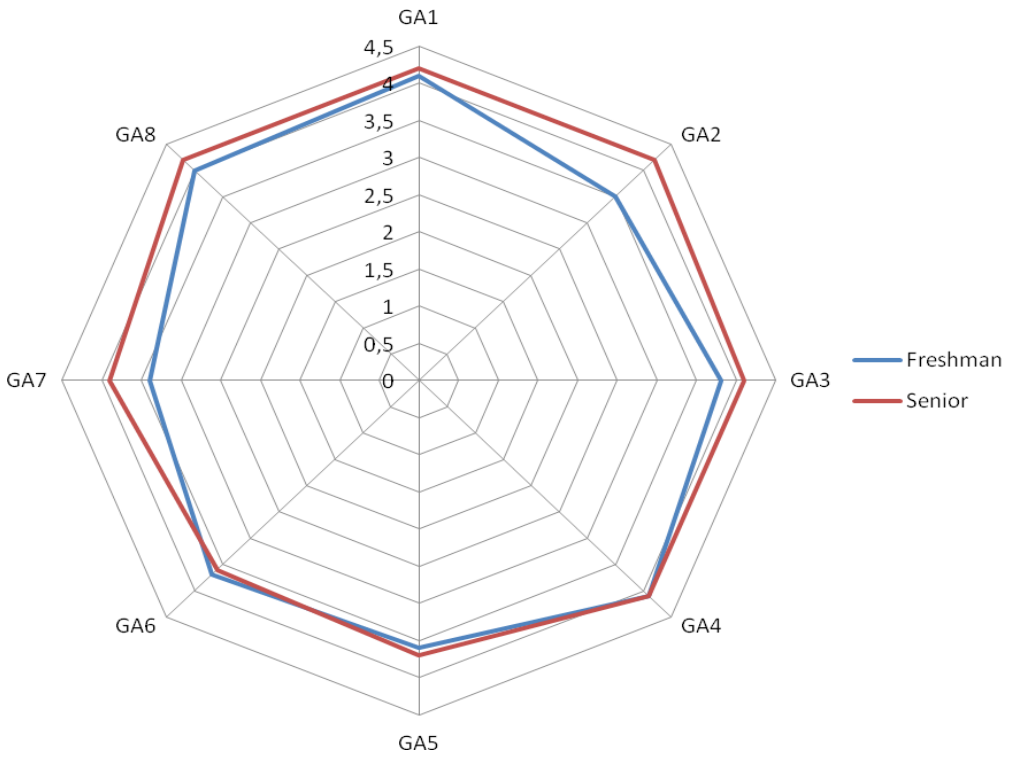

Figure 1. Perceived importance of STRENGTH EHS green abilities in chemical engineering students

Current level of skills and green abilities is relatively poor at freshmen, while at seniors group of students is judged to be moderate (Figure 2). Senior students posed significantly different level of green skills ($p<0.05$) at all items with large effect size (eta squared>0.14). Self-assessed green abilities development at senior students was judged to be significantly moderate to high at all survey items (GA1-8).

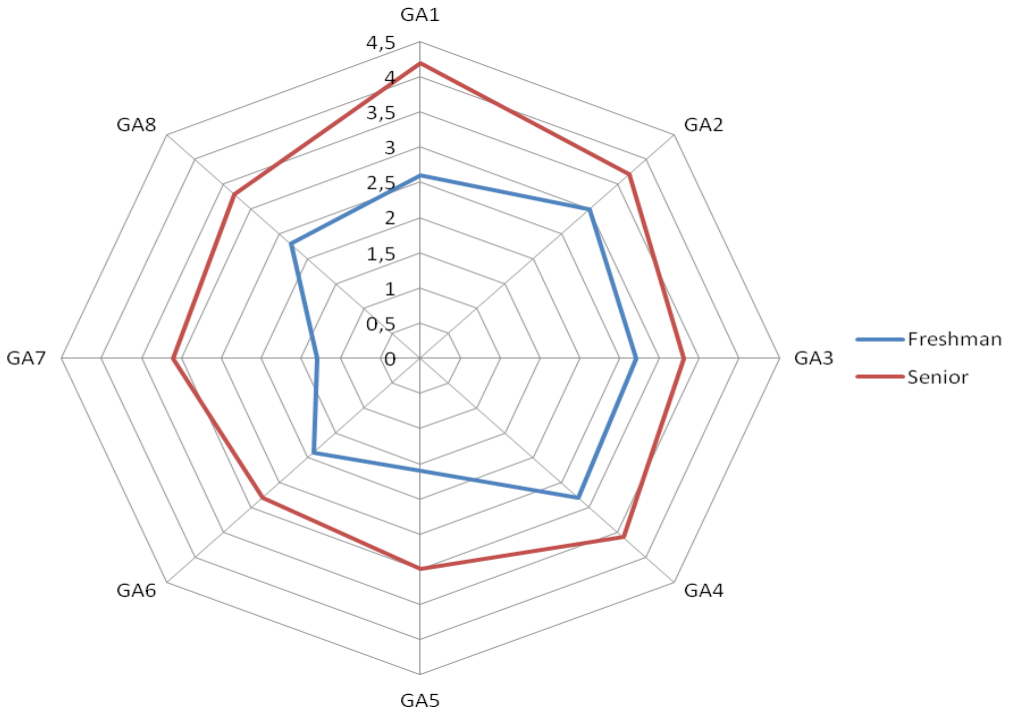

Figure 2. Self-assessed level of STRENGTH EHS green abilities in chemical engineering students

Green abilities acquisition or mastering is distributed almost evenly across the gender; with one exception at GA1 where male students reported higher scores at fundamentals of chemical composition, structure, and properties of substances application achievement. A difference is significant ($p<0.05$) with moderate effect size (eta squared=0.53). Used teaching methods suit both males and females.

Conclusions

The research findings from the present study reveal the importance EHS course design and outcomes.

It is proved that EHS competencies structure is well designed and important for chemical engineering students. Students' perceived importance of green

competencies revealed a high level of self-regulation, and motivation towards green jobs' potential, while knowledge of hazardous waste treatment, safety and risk management were decisive for senior students. Green chemistry is satisfactorily implemented during chemical engineering study. For advances; structural changes in curriculum are needed. Senior students significantly higher estimated current level of green abilities mastering. Some abilities need to be enhanced more, such as "Maintenance of an in-depth knowledge and implementation of environmental, safety and industrial hygiene regulatory requirements and best practices" and meta-cognitive skills for "Evaluation and management of environmental, social and health impacts".

A significant lack of self-assessed knowledge is detected at to "Maintain EHS Management Systems, including ISO 14001 registration" and at competence to "Administer Process Safety Management (PSM) and Risk Management Planning (RMP) programs, including Process Hazard Analysis, Pre-startup Safety Review and Management of Change". In general, environmental management knowledge and skills is lacking in existing curriculum and STRENGTH courses show potential to introduce new and important contents into education and training for competitive green jobs.

Many opportunities exist for chemical engineers to support the goals of green engineering. Profession of chemical engineer has made great strides in this effort, but there is still much more to be done. Expediency is essential as is the need for greater corporate and education participation, making it our social responsibility to encourage industrial organizations, educational and research institutions, training and human resource centres, and policy makers to get involved. Perhaps the greatest challenge facing green chemical engineering is the eventual elimination of all environmentally harmful chemical products. In other words, when designing compounds for a particular application, how can we ensure from their conception that they have low toxicity and rapid biodegradability while retaining their desired effect? Chemists are still a long way from being able to predict the properties (both chemical and biological) of compounds on the back of an envelope. Reaching that point is a daunting task, but it will inspire the next generation of chemists.

Further research is required to replicate these findings amongst the other samples, and to identify whether there are specific variations in green practices, and styles that

are particularly salient to the development of the research skills, problem-solving ability, and critical thinking and decision-making green abilities.

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A STEP TOWARD UNIVERSAL COMPETENCY PROFILER

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Abstract

Last decade, the competences, competency and competency profiling have been recognized as the core information and process to provide basics for implementation of efficient interchangeable widely recognized education and worldwide employment. Competences are components of a job which are reflected in behaviour that are observable in a workplace. A list of the knowledge, skills, and abilities necessary to perform a job well is determined as competency profile. Types of skills listed in a competency profile depend on the job and the work environment. Generally, employers make competency profiles either to evaluate candidates for a job or determine where an employee needs to improve performance to meet the needs of the position. Competency profiles are usually used as a part of competency-based human resources management. They are similar to job descriptions, but they provide ways to evaluate how the employee's skill set and job performance measure up to the requirements. Preparing EQF and NQF based job / profession profiles and related sets of competences (knowledge, skills, other / wider competences) is still ongoing process. In the contribution we present the theory and model behind the competence profiler we developed, the data architecture and the user interface of the e-tool itself. As can be observed, although it was developed for competency profiling in chemical engineering and contains exemplary selection of ISCO job profiles, its usage is not limited for areas or fields of expertise or job / profession profiles.

Keywords: competitiveness, competency, competency profiling, competency-based education and training

Introduction

To change the current unsustainable trajectory of the global ecosystem and to remedy lingering stagnation from the financial crisis, key actors are proposing

revolutionary economic reforms where a new economy ought to be based on Green Growth [1]. Green Growth goes beyond growth balanced with environmental protection; Green Growth is quality-oriented, low-carbon, energy efficient growth with a focus on creating value through clean technology, natural infrastructure and innovation in markets for environmental goods and services. Green Growth strategies should aim to break the vicious cycle between environmental deterioration and unsustainable economic growth-poverty and replace it with a virtuous cycle of quality growth, environmental enhancement and social inclusiveness (i.e., climate action, energy security, sustainable housing) [2]. The macro-level of governance refers to national and supranational policies. A key driver of Green Growth at the macro level is the race to improve competitiveness. Competitiveness is advocated as the recipe for growth at the firm, national and global level [3, 4] thus conciliating national and supranational interests. Country competitiveness can be defined as the ability of a nation to produce goods and services that meet the needs of international markets while maintaining or expanding real incomes [5]. Interestingly development of stringent environmental regulation can be viewed as an effective path to improve national competitiveness [6]. Competitiveness drivers in the green goods and services sectors are e.g. costs, quality, food safety, technology and coordination, pricing and import conditions [4]. The meso-level of governance includes industry and firms. The meso-level has a profound influence on Green Growth. Sectoral competitiveness is a critical link between business and national competitiveness [7]. Schumpeter [8] emphasizes that economic growth is administered by the state but driven by the capitalist enterprise. At this level, Green Growth will still be driven by the quest for profit, more specifically profiting from ecological crisis through the exploitation of green markets [9].

The transition dimensions are in turn intertwined with three core drivers of Green Growth: innovation (technological but also social); globalization (economic but also cultural and institutional); and ecological urgency. Globalization refers to a series of qualitative and quantitative processes of changes in cross-borders flows of goods, services, capital, knowledge and people. Technology is one of the key processes underlying economic globalization, and both globalization and technology are related to the spread of trans-boundary pollution and economic growth [10]. Encouragingly, Green innovation is growing at different levels in developing countries. A very important role plays human resource management (HR). HR practitioners must be ready for innovative actions taken to leverage the talents of organizational members.

The new role of HR management demands an outlook that differs considerably from the compliance mind-set. HR management practitioners are expected to be experts on leveraging human talent within their organizations for the purpose of achieving competitive advantage. They must demonstrate new sensitivity to the full range of human capabilities (including emotional intelligence), align HR efforts with strategic objectives, and integrate various HR activities so that people are consistently encouraged to achieve desired results [11].

Traditionally, job analysis-the process of identifying the work that people do-has been the foundation of HR department activities. According to a classic treatment by Walker [12], a job analysis has four possible purposes. Each purpose provides a view of the job from a different angle; therefore, each is identified by a slightly different approach. One purpose is to discover what people do in their jobs. This approach takes a close look at the reality of the jobs. A second purpose is to find out what people think job incumbents do in their jobs. This approach seeks to gather perceptions about the jobs. A third purpose is to ascertain what people or their immediate supervisors believe job incumbents should be doing at their jobs. This approach determines the job norms. A fourth purpose is to determine what people or their supervisors believe job incumbents are doing or should be preparing to do in their jobs in the future should changes occur in their workplace. This approach to job analysis emphasizes planning for changes [13].

A *job description*, which tells what the incumbent does, and a *job specification*, which clarifies the minimum requirements necessary to qualify for a job, are major outputs of job analysis. Job descriptions and job specifications, in turn, are key to such HR functions as employee recruitment, selection, training, and performance management [11].

One problem with traditional job descriptions is that they are written only to clarify those activities job incumbents are supposed to perform and may not clearly describe measurable worker outputs or results that meet the requirements for organizational success. *Outputs* or *results* are the products or services that workers produce and deliver to others; recipients might include co-workers, constituents, customers, or persons or organizations external to the workers' organizations. Outputs or results should be produced to a level of quality that meets or exceeds the receiver's expectations [11].

Another problem with traditional job descriptions is that they quickly become outdated. In today's dynamic organizations, work activities do not remain the same for long. Job descriptions, however, rarely keep pace with changes in work requirements. That leads to much confusion as people try to figure out whether a job description is current or outdated [11].

At traditional job description model, workers are left to guess about the measurable outputs or results they are expected to produce, in what form, at what level of quality, and on what schedule. Sometimes workers are not alone in playing this guessing game. When they put those questions to a supervisor they might be greeted with a blank stare or given answers too vague to make sense. Frustrated, workers continue doing what they have always done-or what they have seen others do-without knowing for certain whether they are achieving desired outputs. But when customers, supervisors, or managers do not receive the products or services they expected on time or of sufficient quality, they blame the worker [11]. This scenario illustrates a possibly three-fold problem. First, there might be a mismatch between workers' capabilities and the outputs or results they are required to produce. Second, the information provided could be inaccurate or incomplete. Third and finally, the expected outputs might not conform to traditionally defined jobs that are rigid, compact, and inflexible.

The point is that job descriptions are not enough. Joinson [14, p. 12] suggested that "one option is moving away from skills-based descriptions and toward 'job roles,' focused on broader abilities (a set of knowledge, skills and wider competences), that are easier to alter as technologies and customer needs change." Although it is true that well-prepared job descriptions can be a powerful tool, keeping them clear and current is a major challenge that exceeds the grasp of many organizations today.

Therefore, the main purpose of our paper is to determine a competency profiler, which will be able to overcome all of these aforementioned problems.

Competency profiling

Much has been written on Competency Profiling. It is a well-known term within HR circles in corporate organisations. Once the exact functions of a job have been identified, the next step is to conduct competency profiling to identify appropriate units of competency (or a full qualification) to meet the requirements of the job. The

units of competency may need to be customised (or adapted) to ensure the learning outcomes match the specific needs of the enterprise and learners. Competency Profiling is typically a method for identifying specified skills, knowledge, attitudes and behaviour necessary to fulfilling a task, activity or career. In most commercial organisations its ultimate purpose is to provide value to the external customer. All organisations need to be able to match the competency profiles of their people, to their business drivers and strategies. It is therefore becoming increasingly important for enterprises to assess and validate the competencies of individual employees against job requirements.

In categorising competence, some organisations make distinctions between competencies, which refer to desired personal attributes and behaviours and competences, which are the knowledge and skill required to bring about improved performance. Competencies should be seen as [15, p. 28]:

"a signal from the organization to the individual of the expected areas and levels of performance. They provide the individual with a map or indication of the behaviours that will be valued, recognized and in some organizations rewarded. Competencies can be understood to represent the language of performance in an organization, articulating both the expected outcomes of an individual's efforts and the manner in which these activities are carried out".

Competency has been defined in different ways. Some see competency as an underlying characteristic of an individual that causally relates to superior performance in a job or situation. s is a fairly wide definition and includes aspects such as [15, 16]:

- *motives*, for example the motivation to achieve;
- *traits and attitudes* such as conscientiousness;
- *self-concept*, say the level of self-confidence;
- *knowledge*;
- *behaviours or skills*.

Excellent performers on-the-job demonstrate these behaviours much more consistently than average or poor performers. Competencies provide significant help with key problems such as [17]:

- Clarifying workforce standards and expectations.
- Aligning individuals, teams and managers with the organization's business strategies.
- Creating empowerment, accountability and alignment of coach, team member and employer in performance development.
- Developing equitable, focused appraisal, and compensation decision.

Competencies only include behaviours that demonstrate excellent performance. Therefore, they do not include knowledge, but do include "applied" knowledge or the behavioural application of knowledge that produces success. In addition, competencies do include skills, but only the manifestation of skills that produce success. Finally, competencies are not work motives, but do include observable behaviours related to motives [16, 17].

Competency models can be organized as flexible tools that can be used to support various practices such as [17]:

- Employee orientation
- Employee development
- Performance management and coaching
- Career strategies
- Candidate interviews
- Team assessment
- Succession planning

Competencies are generally presented with a definition and key behavioural indicators [17]:

- Responds to customer's needs in a manner that provides added value and generates significant customer satisfaction.
- Demonstrates a deep understanding of internal and external customers and their needs.

- Mobilizes the appropriate resources to respond to customers' needs.
- Takes personal responsibility for customer satisfaction (e.g., focuses on value added interactions).
- Builds credibility and trust with the customer through open and direct communication (e.g., uses effective listening skills, provides timely feedback etc.).
- Ensures that customers believe their issues and concerns are given highest priority.

Competencies do not include "baseline" skills and knowledge (i.e. commonly expected performance characteristics such as finishing assigned work, answering the telephone, writing follow-up letters, etc.), job tasks, or unusual or idiosyncratic behaviours that may contribute to a single individual's success.

There are several types of competency [15]: (1) Universal - These are competencies that could be seen to be related to performance in just about any job. From the sample framework, examples would be "Interpersonal Skill" and "Oral Communication". (2) Occupational - These are competencies that relate to a specific job or family of jobs. In the sample framework, "Leadership" might be an example of an "occupational" in that it does not apply to the vast majority of jobs. (3) Relational - What is required in a particular job can vary widely according to the particular setting of the job.

Much used in technical and further education fields most practitioners argue it is imperative to separate out the levels of competency to provide meaningful assessment. For example levels can include [18]:

- practical competence: the demonstrated ability to perform a set of tasks
- foundational competence: demonstrated understanding of the what and why to carrying out the tasks
- reflexive competence: the ability to integrate actions with an understanding of action so that learning occurs and changes are made when necessary, and
- applied competence: the demonstrated ability to perform a set of tasks with understanding and reflexivity.

Benefits of implementing a competency-based approach

Benefits of implementing a competency-based approach to modern HR should be demonstrated as three-fold model, namely: for the company, for managers and for employees.

At the Company level, competency-based practices [17]: (1) Reinforce corporate strategy, culture and vision. (2) Establish expectations for performance excellence resulting in a systematic approach to professional development, improved job satisfaction and better employee retention. (3) Increase the effectiveness of training and professional development programs by linking them to the success criteria. (4) Provide common, organization wide standards for career levels that enable employees to move across business boundaries.

Managers will be capable to [17]: (1) Identify performance criteria to improve the accuracy and ease of the hiring and selection process. (2) Provide more objective performance standards. (3) Clarify standards of excellence for easier communication of performance expectations to direct reports. (3) Provide a clear foundation for dialogue to occur between the manager and employee about performance, development and career related issues.

At Employees, competency-based practices allow to [17]: (1) Identify the success criteria (i.e., behavioural standards of performance excellence) required to be successful in their role. (2) Support a more specific and objective assessment of their strengths and specify targeted areas for professional development. (3) Provide developmental tools and methods for enhancing their skills. (3) Provide the basis for a more objective dialogue with their manager or team about performance, development and career related issues.

Defining competency provides the foundation for recruitment and selection strategies. For existing workers, knowing specifically what skills and knowledge are required of them enables them to assess their ability to provide them. This gives them an opportunity to appreciate their own strengths, and recognise gaps, or areas requiring development. Being aware of areas where they could improve means they can then consider and plan how to address those gaps as part of a competency-based learning program.

Competency models are developed through a process of clarifying the business strategy and determining how the models would be used. While it can be a very

complex exercise depending on the size and nature of the enterprise, there are a few broad steps involved [19]:

1. Project Planning - meeting with stakeholders to clarify the scope and objectives of the profiling exercise, and discussing approaches to competency identification, implementation, communication and administration.
2. Benchmarking - reviewing job descriptions, training materials and competency models for similar positions within the enterprise.
3. Profiling - using one or more approaches such as interviews, focus groups, questionnaires or direct observation to identify the knowledge, skills and behaviours underlying successful job performance.
4. Validation - reviewing and refining the competency profiles with stakeholders and documenting the results.

Competency models

A competency model can be an effective way of communicating to the workforce the values of the senior management and what people should focus on in their own behaviour. For example, a competency based appraisal system helps to distinguish individuals with the characteristics that are required to build and maintain an organization's values (teamwork, respect for individual innovation or initiative) from those who do not exhibit the behaviours that will support these values. In this way competency models can translate general messages about needed strategy and culture change into specifics. Over the years many different methods of developing competency models have evolved but all of them follow McClelland's lead of determining what leads to superior performance, identifying top performers and finding out what they do [16]. There are two principles that are followed in these models:

1. Focus on the superior performers without making an assumption.
2. Focus on what they do to perform the given role.

There are various developed models that are used as a basis for selection, training, promotion and other issues related to HR, namely [16]:

1. Job Competence Assessment Method - This is developed using interviews and observations of outstanding and average performers to determine the competencies that differentiate between them in critical incidents [11].
2. Modified Job Competence Assessment Method - This also identifies such behavioural differences, but to reduce costs, interviewees provide a written account of critical incidents.
3. Generic Model Overlay Method - Organizations purchase an off-the-shelf generic competency model for a specific role or function.
4. Customized Generic Model Method - Organizations use a tentative list of competencies that are identified internally to aid in their selection of a generic model and then validate it with the input of outstanding and average performers.
5. Flexible Job Competency Model Method - This seeks to identify the competencies that will be required to perform effectively under different conditions in the future.
6. Systems Method - This demands reflecting on not only what exemplary performers do now, or what they do overall, but also behaviours that may be important in the future.
7. Accelerated Competency Systems Method - This places the focus on the competencies that specifically support the production of output, such as an organization's products, services or information.

As we see, there are several approaches with solid underpinnings from which to choose. The process used to develop a model must be straightforward and easy to implement. The final product must have immediate practical application, commitment and buy-in for those who will be expected to implement or change their behaviour based on it. The development process should include a step to ensure that the behaviours described in the model correlate with effectiveness on the job.

Strength competency profiler

The green transition will require the development of a better understanding of the implications of green jobs on competitiveness, green growth, and health and safety at the workplace. On the one hand, measures aimed at environmentally friendly workplaces can help to improve working environments, having a positive impact on workers' safety and health, and enhance green growth. In order to shape the future of occupational sustainability, competitiveness, added value, safety and health in green jobs and inform EU decision makers, Member States' Governments, trade unions and employers, the European Agency for Safety and Health at work carried out research about the new and emerging risks associated with green technologies by 2020. Considering this research, the Leonardo da VINCI TOI Project STRENGTH (Structuring of Work Related Competences in Chemical Engineering), 2013-1-ES1-LEO05-66726, developed green matrix of key green competencies areas for chemical engineering, namely: agriculture; biotechnology; environmental, health and safety; food science, and pharmacy.

STRENGTH tool for competence description is centred on chemical engineering sector for green jobs development and generation of relevant to them organizational and individual professional profiles. Vocational sector competencies of chemical engineering according to European Qualification Framework (EQF) levels 6 and 7 [20] and creation of a competence matrix as e-data base of green skills and competences descriptions with generation of organizational and individual professional profiles are described in the following section. Competence areas and entire matrix development also strictly followed principles of the European Credit System for Vocational Education and Training (ECVET) [21] to obtain inter- and international comparability, competencies recognition and equal opportunities at labour market. STRENGTH mobility mechanism well fits current needs and requirements of individuals and / or organizations for training and developing of green competencies [22].

The tool is part of the project STRENGTH website [22], Figure 1. It was developed as online application with administrative (back-end) and public (front-end) part and it is integrated as a standalone PHP application inside project website engine Joomla!

Figure 1. STRENGTH project website, hosting information about the project and the tool

In the continuation we present the semantic model for the tool that served as the motivation and some screenshots from the tool. The semantic model served also for related tool's entity relationship model for data storage and advising functionality.

Competency profiler development

The tool was developed according to the following basic semantic model:

- Competences: core of the model and "everywhere present" entity are the competences which represent knowledge, skills and wider competences.
- Areas: most competences are connected with some specific area or areas. In case of STRENGTH project, these areas are pharmaceutical industry, food science and technology, agriculture engineering, biotechnology, and environmental, health and safety.
- Courses: if we "exclude" competences that an individual can obtain from elsewhere, competences can be formally obtained in formal or informal courses, seminars, workshops, etc. For example, at some course individual can obtain first list of competences, on a second course second list, and similar to other courses. Courses are or can be mutually independent, but can have same competences in their list of competences (e.g. competences 1 and 2). Lastly, when individual is successful at course, he / she can get some kind of recognition document about that, e.g. certificate. By their basic meaning, courses are connected with areas.
- Job profiles: on the other side we have jobs, and regardless if they are in private or public sector these jobs can be also seen from competence point of view as a list of competences defining corresponding job profiles. Similar to courses, also jobs and job profiles are connected with areas.
- Individuals: apart from the theoretical side (competences, areas, courses, job profiles), we have the most important integral part of whole image representing practical side - the individuals. Individuals can have some kind and level of education, and can have job (s). Regardless of that, they can be also observed through the list of competences.

Courses, jobs, job profiles and individuals can be described as lists of competences also called "competence modelling" or "competence mapping". They can be also understood as a "need - have - offer" model (NHO model) as shown in Figure 2.

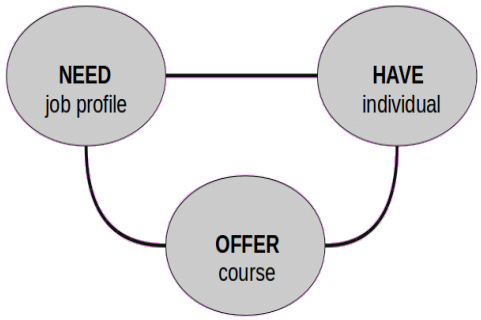


Figure 2. NHO (need - have - offer) model

For more realistic competence modelling, levels have to be added (Figure 3). Namely, course don't necessary treat all the competences in the same course at the same level; also for some jobs some competences are needed on higher levels than others; and the same applies for the individuals.

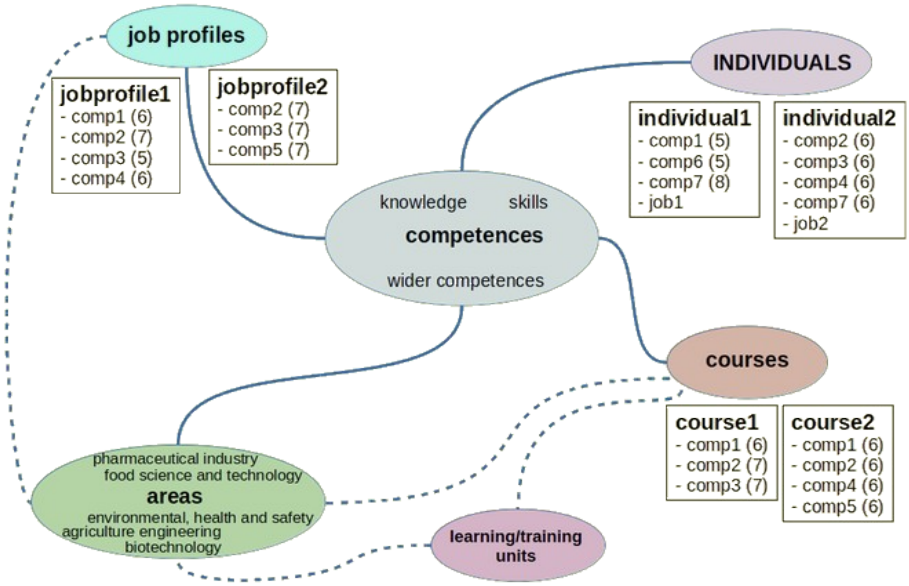


Figure 3. Competency modelling semantic model

By using the semantic model, several real world questions can be answered, for example: (1) Which jobs are in the "food science and technology" area? (2) What I need

to know, what must be my skills, and what I have to master for job X? (3) Which course or courses I need to take for job profile X? (4) Where can I get all needed knowledge, skills and etc. for job profile X? (5) What is my level of competency? (6) Which job is "nearest / closest" to me?, etc.

Answers to questions 1 - 3 are very straightforward and can be answered by using the tool on project website. Question 4 is closely related to the project results. Some projects offer learning, while other projects prepare the requirements, guides and suggestions for institutions and other interested parties to prepare their own learning functionality (course management, course materials, course implementations, teaching and administrative staff, course documents, etc.).

For question 5, the tool CPA offers assessment based on description of marks. Alternative to that is formal assessment which is usually done by competent approved institutions; however they can also use these descriptions. Basis for (self) assessment by using the tool is the description of competency assessment as shown in Table 1. Marks 1-3 are considered as "passed".

Question 6 is especially useful for individuals who seek for new job opportunities and would like to obtain new competences based on the following objectives: (1) The smallest number of competences that have to be obtained; (2) The smallest number of courses that have to be taken; (3) The smallest number of competences using weights for different levels, etc.

Table 1. Assessment description of competence "knowledge 11" for EQF level 6 in project area "environment, health and safety"

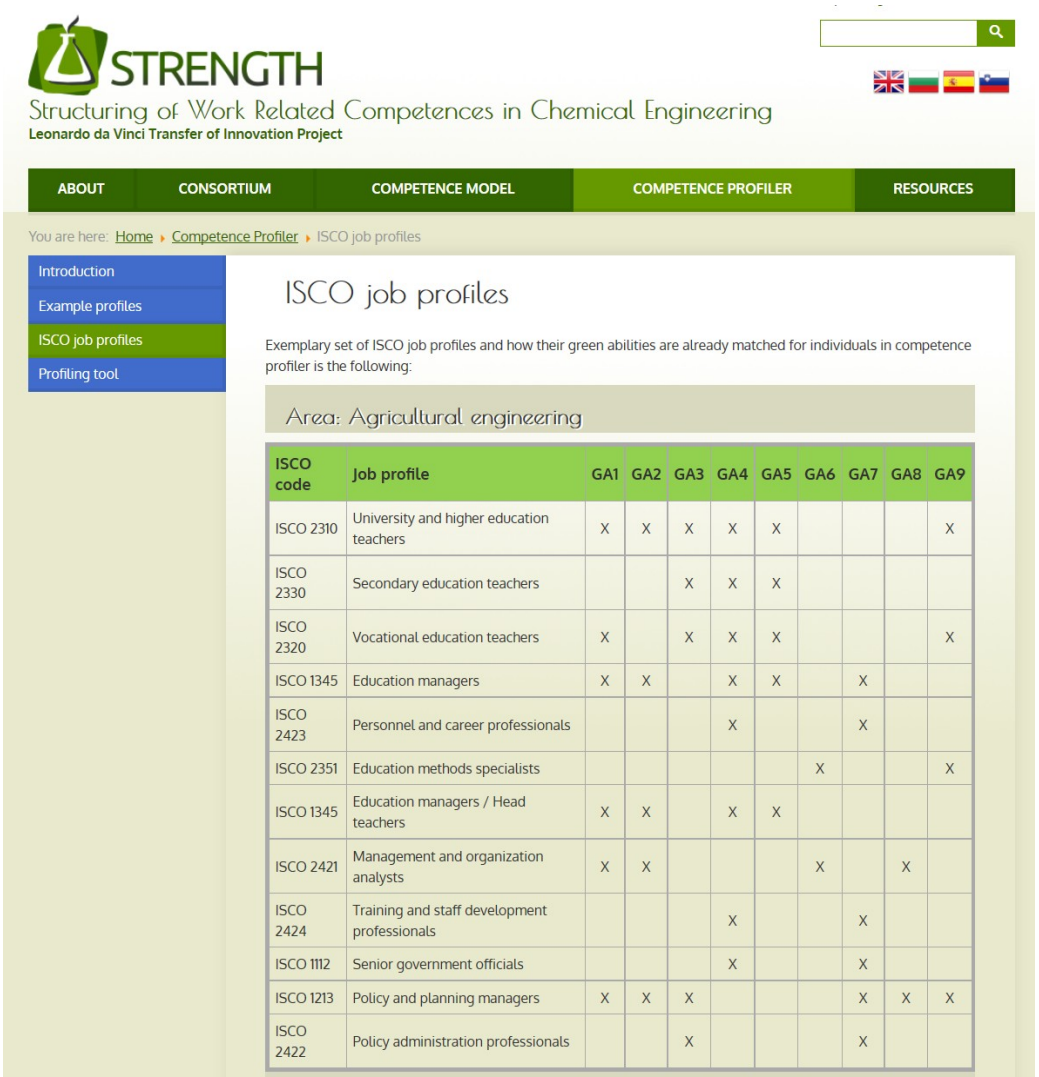
Competence (learning / training outcome)	**Benchmarks (B) (assessment criteria)**	**Guidelines for (self) assessors**	**Marks / grades**
Perform emergency / crisis management in terms of planning and response, including incident investigation to ensure thorough root-cause analysis and comprehensive corrective action.	B1: Potential incidents and malfunctions are identified. B2: Root-cause analysis is performed and corrective actions are designed. B3: Operational plan for active / effective implementation is made.	No incidents or / and malfunctions are identified.	0-no competency
		Potential incidents and malfunctions are identified.	1-satisfactory
		Potential incidents and malfunction are identified and validated.	2-good
		Action plan for effective crisis management is made (implementation ready).	3-excellent

All mentioned objectives are mathematical optimization problems where one seeks a minimum. List of competences that are connected to courses and set of courses are called organizational professional profiles, while the missing competences of individuals to cover organizational professional profiles are called individual professional profiles.

First objective is especially useful in cases where courses are implemented as modules and subsets of modules can be recognized as granted according to individuals' lists of competences. The most realistic is the third objective because it takes into account the hardness and spent time (e.g. credits) and correspond to individuals' expectations about learning "harder and more" or “easier and less”. By answering to these questions the tool acts as an advisor.

Competency profiling

STRENGTH needs analysis revealed the following important sectors of green job perspectives in chemical engineering sector: Agricultural engineering, Biotechnology, Environmental, health and safety, Food Science and Technology, and Pharmaceutical Industry. A significant gap between labour market needs and formal education acquired competences was detected. Considering International Standard Classification of Education (ISCED) and International Standard Classification of Occupation (ISCO) project STRENGTH developed ECVET-based courses aimed for development of green abilities in competence matrix areas. Educational and training organization from green chemistry is able to prepare their own organizational profile of relevant competences / courses for training program / qualification on EQF level (e.g., 6, 7). Courses are ready for use with specific target groups, considering the market needs and wants. For each of five competence area, a mapping of existing or already acquired competences was done (Figure 4) as an important input in the profiler.



ISCO code	Job profile	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9
ISCO 2310	University and higher education teachers	X	X	X	X	X				X
ISCO 2330	Secondary education teachers			X	X	X				
ISCO 2320	Vocational education teachers	X		X	X	X				X
ISCO 1345	Education managers	X	X		X	X		X		
ISCO 2423	Personnel and career professionals				X			X		
ISCO 2351	Education methods specialists						X			X
ISCO 1345	Education managers / Head teachers	X	X		X	X				
ISCO 2421	Management and organization analysts	X	X				X		X	
ISCO 2424	Training and staff development professionals				X			X		
ISCO 1112	Senior government officials				X			X		
ISCO 1213	Policy and planning managers	X	X	X				X	X	X
ISCO 2422	Policy administration professionals			X				X		

Figure 4. Preacquired green abilities for ISCO job profile

Considering the durability of knowledge, skills and broad competences, every learner / trainee has an opportunity to self-evaluate existing green ability, and afterwards consciously choose adequate training course or green ability. By click on profiling tool button, a trainee may choose competences needed for competitive mastering of a new green profile. For example, if a trainee is a vocational education teacher, he has already acquainted competences in red, and he needs to know more about Environmental management (Figure 5) claimed with job position / profile or

with new subject matter he got. For acquiring of this competence, course of AE 01: Design of agro industries and AE 08: Rural development and agricultural policy must be taken. Nevertheless, a trainee felt not comfortable at competence of Environmental challenges or advantages associated with innovative technologies implication, thus, he decided for refreshment courses, AE 01, AE 03, AE 06 (blue labelled). In total, a trainee will be awarded with 20.5 European Credits (EC) when he / she passed the individual profile learning pathway.

After competences mapping, a selection is sent for personal folder and to VET organizer in order to prepare ECVET records and other mobility documents.

A trainee has also an inversely option, to choose the course, which he / she needs / wants to take and afterwards, competences / green abilities are listed.

A part of the competency profiler is also an assessment / evaluation / selection tool (Figure 6). For example, the competence area of Agricultural engineering for green jobs is successfully covered with nine green abilities. Those green abilities are aggregated from knowledge, skills and wider competences, related to green chemical engineering. An importance of this tool is threefold. Firstly, a trainee can evaluate (self-asses) a level of competences acquired in a course (individual development) and a trainee should be assessed on that scale by a supervisor or by other from managerial staff. This assessment allows employee selection and retention. Secondly, a trainee or employee may asses an importance of competences for job profile, for organizational profile to obtain more competitiveness or added value of a particular job profile. Thus, we can balance competences in time, and control the entire profile to be not outdated. Thirdly, managers might use the tool to select best workers or successors for continuity of company tradition and competitiveness (succession planning). Outputs or results should be produced to a level of a quality that meets or exceeds the receiver's expectations.

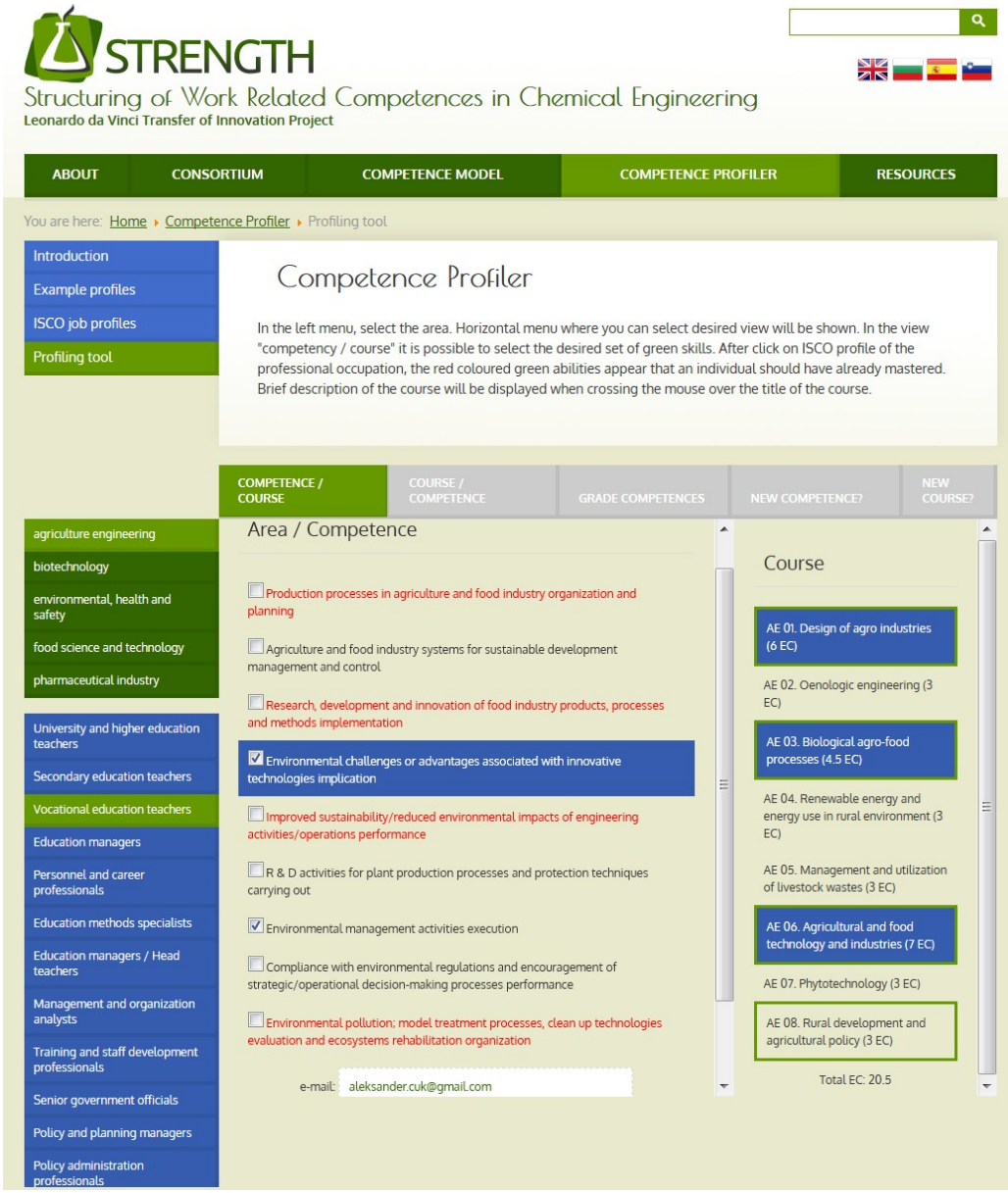


Figure 5. Competency profiling of vocational education teacher for agricultural engineering green ability acquiring

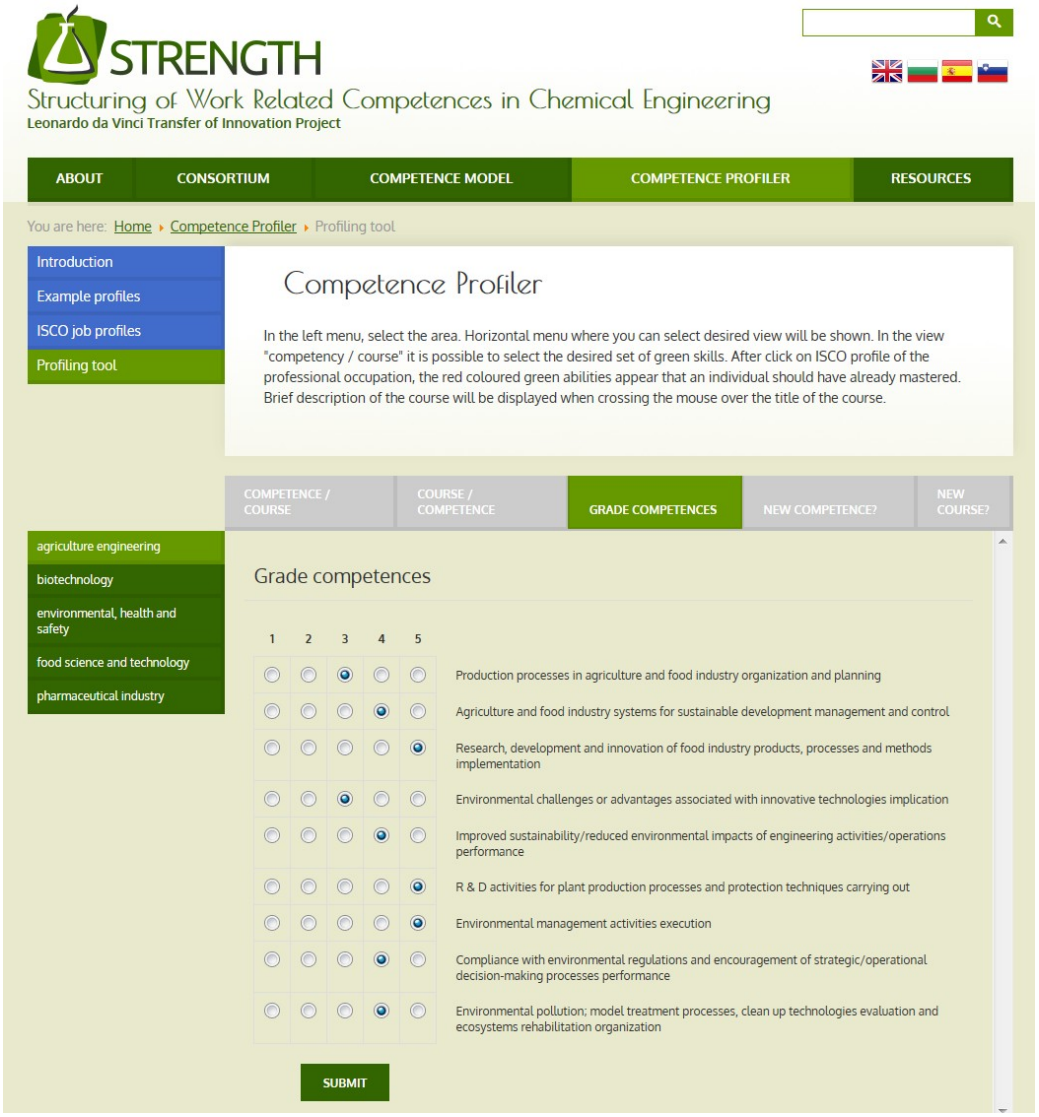


Figure 6. Competence assessment / evaluation / selection tool

A competency profiler tool enhances refreshments or elevates added value of any job profile. Any stakeholder, scholar or web site visitor can contribute to the upgrade / update the list of competences, by proposing new or modified competence. Simply, by click on the New competence button, write down a title and short description of competency for new job profile, and afterwards submit to administrator or

competencies profiles keeper (Figure 7). Similar, a new course for agricultural engineering green competences acquiring should be proposed (Figure 8).

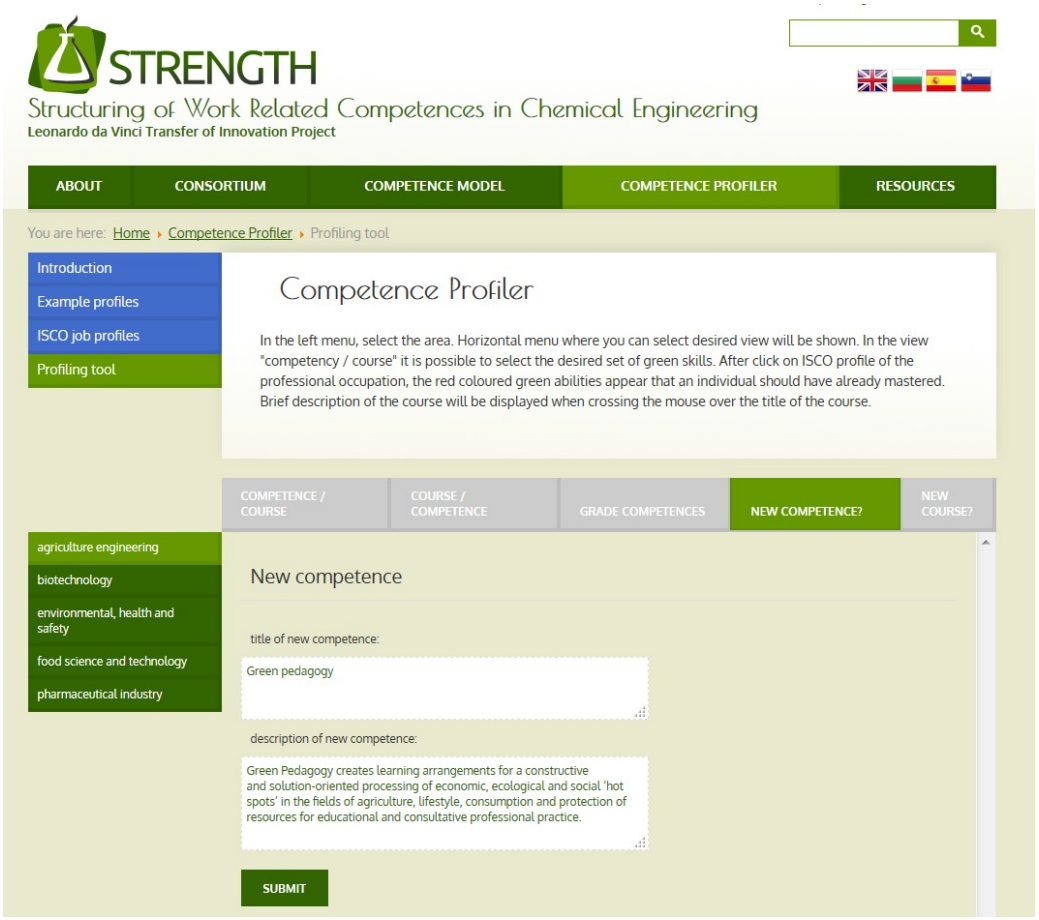


Figure 7. Competencies dynamism tool- proposing a new competence

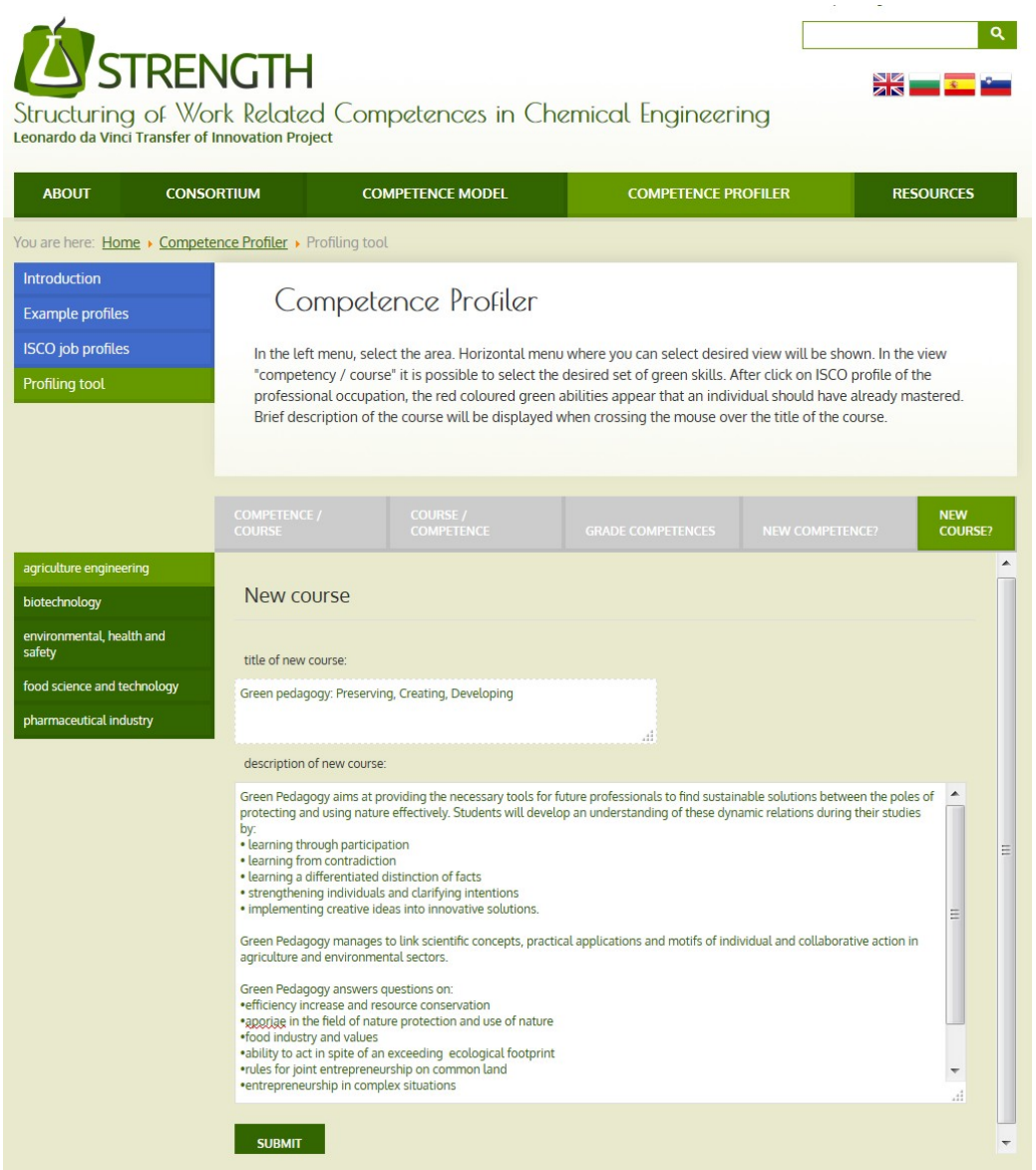


Figure 8. A new, proposed course of "Green Pedagogy: Preserving, Creating, Developing", for agricultural engineering green abilities acquiring

Conclusions

Developing and describing matrices of competences in relation to courses and profession profiles is a well established process. Several institutions tackled that,

most intensively in recent Bologna process. Vocational education and training is still having gaps in that and project STRENGTH - Structuring of Work Related Competences in Chemical Engineering tries to fill them in five areas related to chemical engineering.

As part of the project, the tool for defining competence matrices in multi-language setting was developed. In addition, the tool was equipped with the intelligence of an advisor helping individuals seeking additional professional education, or seeking new entrepreneurship opportunities by finding suitable job profiles, individual professional profiles and courses for them.

STRENGTH competency profiler overcomes all of current competence / job descriptions model weaknesses, namely: (1) Competence upgrade / refreshment is enabled. Promptly upgrade / update of competences, green abilities, and courses are enabled. (2) All outputs or trainee's / employee's results are measured, monitored, and also benchmarked for competence importance. (3) A mismatch, between workers' capabilities and the outputs or results they are required to produce, is reduced. (4) The information provided through competency profiler is accurate or complete, and (5) The expected outputs might conform to competency-based HR and job profiles (organizational, individual) are dynamic, adjustable, and flexible.

Real world competency profiling developed in STRENGTH project is ready for the general public, and it is flexible enough to be adjusted with different sectors specificities.

Future work on competency profiler is needed to obtain competencies database, especially, a work with managerial staff and HR from different sectors is needed. An eco-economics tool is proposed as new functionality of competency profiler, including technological matrix and forecast mechanism of a job profile added value. Green jobs have potential, also generating by green pedagogy, which should be included at the new competency model development. A re-design of instructional paradigm is needed by introduction of green oriented methods, strategies and approaches to teaching and learning.

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ECO-CREATIVE TRAINING: WIDER COMPETENCES PROFILING SESSION FOR GREEN DESIGN IN CHEMICAL ENGINEERING

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Abstract

As human populations increase in size, extent, and diversity, natural resource planners and policymakers must address growing concerns about a wide range of environments. To make the best decisions - for people and for nature - they need knowledge, skills and wider competences of creative thinking and decision-making, about how people, industry and natural environments influence each other. The human component of natural resource management became important issue worldwide. All forms of creative thinking can be an efficient mean to spread values and ideas important to influence people's minds and have an effect on their ways of thinking and living, thus generating some sort of change that may drive to reduce the impact of human being on the environment. Creative training for green design is important tool where creativity, business ideas, environmental issues and social inclusion come together. Creative design, in fact, thanks to its huge power of communication and capacity of interpreting the contemporaneity is particularly indicated to diffuse a message among young generations, especially engineering students, which are the ones who can really have possibility to change reality. Our research was aimed to reveal what effect it has of a two-day of training in the field of creative thinking on the activation of the creative potential of chemical engineering freshman students. Chemical engineers design both products and processes, and manage and optimize their performance in order to ensure safe that are economically viable and acceptable to the environment. It is important to note that chemical engineers must be able to respond to changing conditions of production. Thus, the success of chemical engineering is not only dependent on a formal or explicit knowledge, but - more than in the science-driven, such as chemistry - is also not explicable or implicit knowledge. Classified information is essential for the creation of tacit knowledge, which is crucial for the ingenuity of creative attitude characteristic of the humans. Hence, this present paper highlights the most appropriate creative thinking techniques that the educators and trainers employ to motivate the green abilities seekers most effective and inspirational for the upcoming generation.

Keywords: chemical engineering, wider competences, creative training, eco-creativity, green design

Introduction

The "green" revolution represents one of the most exciting opportunities of the twenty first century. Governments across the globe have developed incentive programs, directed research money, and emphasized the creation of "green collar" jobs. Green jobs are those jobs that maintain, preserve, and restore the environment while providing a liveable wage. Recently the U.S. Department of Labor's Bureau of Labor Statistics (BLS) proposed a definition of green jobs as those jobs "related to preserving or restoring the environment". The Bureau of Labor Statistics lists seven economic activities under which green jobs fall [1]:

1. Renewable energy
2. Energy efficiency
3. Greenhouse gas reduction
4. Pollution reduction and cleanup
5. Recycling and waste reduction
6. Agricultural and natural resources conservation
7. Education, compliance, public awareness, and training.

These economic activities result in the production of green goods and services that fall into four types [1]:

1. Direct green goods and services (including weatherisation of buildings)
2. Indirect green goods and services (for example, goods containing recycled materials)
3. Specialized inputs (for example, wind-turbine blades and mass-transit rail cars)
4. Distribution of green goods that fall into one of the first three categories.

Couple an interest in green issues and a desire to teach and the result is a career educating people about environmental concerns. This career direction can take many turns. Advocacy groups often hire people to give presentations on environmental topics to educational institutions. There also is a need for educators and trainers who care about the earth and have a love for nature to share their knowledge with pupils, students and adults. Career options vary widely. A specially and important role plays green chemistry. Green chemistry is the design of products and processes that eliminate or reduce significantly the use and generation of hazardous substances and the prevention / reduction of environmental / safety and health impacts at the source [2]. "Green" often focuses on the chemical itself, including environmental aspects only. Sometimes safety and handling aspects are included.

The insight of enormous large amount of chemical engineering waste triggered activities within the chemical industries to reduce waste generation by different measures such as using different and more appropriate / "greener" solvents, or to develop synthesis routes using fewer less steps thus avoiding waste intensive purification steps [3]. This was the eye opener for a broader view that brings the full life cycle of chemical engineering products (Figure 1) into focus, since it could be shown that such approaches can also save high amounts of money, thus rendering companies more competitive. As for chemicals in the environment, it has been learned that several techniques for the reduction of the input of chemicals into the environment are available [4]. However, it was found that each of these approaches has its specific shortcomings. Therefore, additional approaches such as people handling and using the compounds, i.e. doctors, pharmacists and patients. Another approach that focuses on the properties of the compounds came into focus - benign by design - the targeted design of a compound from its very beginning. These two strings of discussion can be connected by providing a broader view taking into account all environmental, social and economic issues. Along the life cycle of an active chemical ingredient and an adjuvant, different issues are of importance with respect to sustainability. These are roughly depicted in Figure 1.

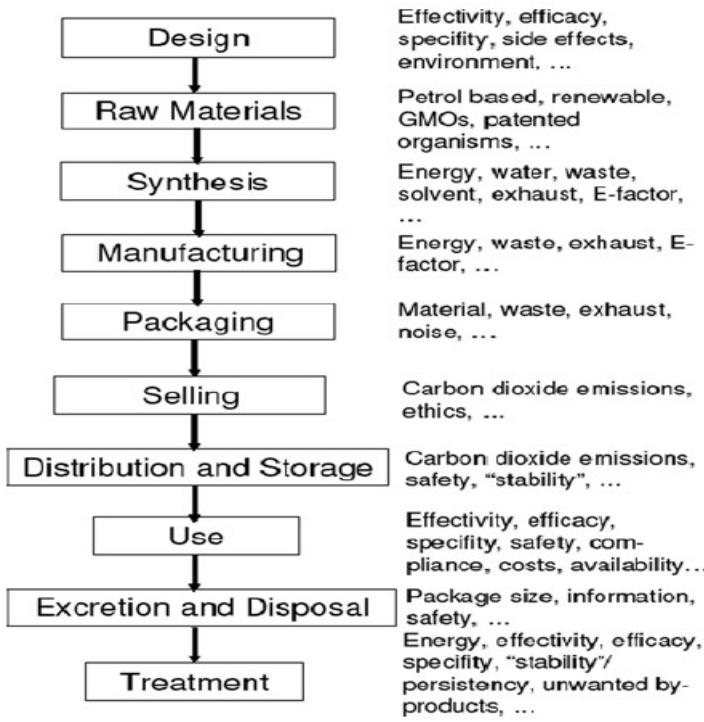

Figure 1. The life cycle of a chemical and some points that are relevant for sustainability [4]

As we can see from the Figure 1, design activity has a special and important role at entire life cycle. Considering green design, the following requirements should be adopted: effectivity, efficacy, specifity, side effects, environment load, healthy and safety issues [4]. At design activity, a lot of knowledge, skills, and creative abilities should be engaged for competitive and innovative design. The innovative success of chemical engineering is on the one hand based on rigorous research and development services, but on the other hand also on a high level of flexibility and customer focus [5]. Thus, the success of chemical engineering is not only dependent on formal or explicit knowledge, but - more than in science-driven sectors such as chemistry or biotechnology - also on non-explicable or implicit know-ledge.

There are two types of knowledge: an implicit (tacit knowledge), existing only in the mind of the man who has it, generated through experience and not fully conscious, manifesting itself only through skilful action and overt (articulated, excavated) (explicit knowledge, formal knowledge) expressed in the form of characters and saved [6]. In

the 50s of last century it was observed that the existence of tacit knowledge is characterized by the fact that we know more than we can say. Often, people gain knowledge through its active create and organize their own experiences. Explicit knowledge, which is expressed in words and numbers, represents only "the tip of the iceberg top" of the full body of knowledge. The concept of tacit knowledge is based on three arguments: 1. The real discoveries can be made using articulated the principles and algorithms, 2. Knowledge is widely attainable, but for the most part is personal, 3. All knowledge is implicit or derived from it. [6] Implicit knowledge is an important kind of knowledge. It is knowledge not expresses explicitly in a character (e.g., in words) by its holder. It is included in the personal experience of its owner. Its formation depends on so elusive traits as personal beliefs, attitudes and values. Implicit knowledge is personal, context-specificity. Consequently, it is subjective, based on the experience (senses), more associated with the practice. It is created "here and now". In a specific context. One of the characteristics of knowledge in general is that its use in the course of solving the problems by a person or group of persons leads to the foreground. New knowledge - initially usually implicit - through its documentation and then made available (through presentations, publications, databases, patents, etc.) becomes explicit knowledge (formal).

Creativity as ambiguous concept is also the subject of interest of many disciplines in the humanities, social as well as technical [7]. In terms of psychological issues related to the work were and are analysed in terms of, inter alia, cognitive, personality traits, developmental processes of social phenomena, psychometrics, as well as practical applications such as training and workouts. Analysing the concept of creativity, should pay attention to the kinds of values and domains. I wish to recall the typology, which presents four domains of creativity, distinguished by the type of activity and predominant purpose [8]. Thus, cognitive values will be aimed at discovering, investigating the truth and the domain of this kind of action will be learning. Aesthetic values will develop in the arts and will show the beauty. The third group of values, in turn, pragmatic values are aimed at usability and creativity is the domain of inventiveness. And as the fourth, the last mentioned are the ethical values which aim at the good of the public domain of creative activity. This typology gives you a broader perspective on human creative activity. It can be assumed that creative scientist is a man focused, concentrated only on the values cognitive- or search for the truth, but considering his creative work more broadly, we note that it can realize the aesthetic and pragmatic.

The creative activity of engineers, which are assigned a pragmatic values, the goal is inventiveness, which is an indispensable element of progress and improve quality of life. However, as shown by the surrounding reality creative engineers move both in the world of pragmatic and cognitive and aesthetic. To cite at this point it is worth interdisciplinary field of science that is where the development of biotechnology and invention, we find the values of all of the aforementioned domains. For example, the creative aesthetic value of biotechnology can be seen in the actions of aesthetics implant and through innovative effects of the active ingredients in cosmetic anti-ageing [9].

One of the recent EU green initiatives project STRENGTH [10] provides strategic advice on formulation of a green economy strategy, engaging global best practices and making connections to global network of green economy lessons learned. It analyses the global trends in green economy with focus on clean technology investments and fiscal instruments to generate efficient use of energy, water, mining, building, transport, and wastes. The project objectives are focused on introduction of the "green abilities" concept to create new opportunities of vocational education and training (VET) teachers and systems to build up green employability skills and further ecological awareness development in job seekers. In this way participants in VET will acquire knowledge and creative ability for new generic employability, green skills and wider competences for performance of personal development, employability and introduction in the European labour market [10].

In spite of several creative training methods aimed for green design, an evidence of effectiveness is still lacking. Therefore, our research had the following two goals: (1) To assess the general level of wider competences of creative thinking in freshman students of the Faculty of Chemical Engineering and Technology University. Cracow. (2) To reveal the impact of a two-day eco-creative training on the activation of the creative potential of participants in such activities.

Eco-training within the creative potential of future engineers

The education of engineering students, in addition to expertise, which gain understanding and then use in their work is the primary goal of higher education. It necessary to consider should also be inspiring, activating and production of creative attitude. Exposing systematic thought processes influence - stimulating, it stimulates

the creation of new solutions, the search for imperfection and to propose eliminating them and make improvements [11]. The introduction of a structured system of humanising the process of engineering education, which is attractive to students ensures the personal development of an engineer-creator. Apart from traditional theoretical lectures, multiple training and workshops play a major part in this process. Using a range of methods and techniques, e.g. educational games, art activities, communication exercises, exercises in pairs, work with the body, psychodrama and relaxation techniques, pedagogical work can be used to activate different ways of receiving and processing information by students [12].

Stimulate creative thinking is a factor that mobilizes for action, while at the same time an incentive to self-stereotype thinking, questioning and stimulate cognitive curiosity. Training creative thinking, it is aimed at developing individual or group of individuals, which has already defined the creative potential, but also has many internal blockages that inhibit the full development of its creative possibilities. These locks are often intellectual, emotional and social development. Critical thinking, problem-solving skills and communication skills are more important than simply knowing the content itself [13]. Motivational processes indicate that learners are self-motivated and willing to take responsibility for their successes or failures. Behaviour refers to the characteristics of the strategies that students utilise to optimise learning and / or training [14].

Psychological studies conducted in the mainstream of cognitive shown that intellectual operations such as the operations of abstraction, metaphorical thinking, making associations, inductive and deductive reasoning or making transformation, are the basis for creative thinking process [15]. It worth noting that these operations are commonly used in processes thinking and problem solving, and creative thinking come so leads to original, unusual solutions, uses the typical cognitive mechanisms.

Another important aspect of the training of creative thinking is its character group. Working in the training group, favours the development of motivation and interpersonal communication. Active listening, rewarding, skill constructive criticism, developing empathy is an element of personality, each participant training. Interactions between training participants simulate the interaction and joint problem solving situations in the future teamwork. Interaction has been deemed one of the most important component in open learning environments where multiple learning objects are used [14]. Creativity training course's interaction framework has been seen

as learner-learner, learner-instructor and learner-content interaction. Learner-learner interaction refers to two-way reciprocal communication between or among learners who exchange information, knowledge, thoughts or ideas regarding course content, with or without the presence of an instructor. Learner-instructor interaction consists of two-way communication between the instructor of a course and learners. Learner-content interaction is a process of individual learners elaborating and reflecting on the subject matter or the course content [14]. Aforementioned interactions were also included at eco-creative training, boosted also by project STRENGTH objectives which were promoted during training (Figure 2).

Figure 2. Creative training for green design in chemical engineering

To boost green design, an eco-creative course was designed considering different techniques as brainstorming, "crushing technique" creating analogies, "sculpture" - work with the body, creating metaphors. Students formed teams of creative, leading to the approval of freely experimented with ideas, made mistakes, but also learned from each other, acting in a given context for the project team and practising the ability to achieve innovative results.

Eco-Creative training course format

The creative thinking training has been designed for 15 periods of active learning in a two-day course. All participants of the training were freshman chemical engineering students at Faculty of Chemical Engineering and Technology at the Cracow University of Technology. Gender distribution of students was not evenly, there were just eight male students out of 49. Students were divided into eight teams with one male student in each team. Thus, an impact of male students at course analysing and problem-solving tasks was normalized.

The creativity training consists of three essential parts: (1) Acclimatization and team building; in the first phase it is the most important to know each other and to establish good communication (skilful listening, asking questions) between persons belonging to particular teams. It is also important to clarify mutually expectations, rules and standards that are applied to training participants. (2) Heuristic rules; in the second phase is the most important fixation (introduced in the first phase) heuristic rules that are applied during a workout and problem-solving activities. In this phase, a further collaboration in teams should be promoted. At the beginning, we point to the refraining from immediate judgement of the person or an idea. A "Provisional list of ideas murder" or phrases that inhibit the activity of creative and motivational-emotional participants is dealt. These phrases must not be used during the training. Participants have to encourage each other to generate and presenting surprising and original ideas. (3) Empowerment; Mutually peer- and / or instructor-scaffolding training to reinforce participants to cross the clichés of thought. In this phase a violation of rules could appears and it is important to warn students to be streamed with the training. Instructor must control the use of by the course design not adopted standards and rules, and control them in tolerance field. The last third phase of the training period is noticeable shift in a way how we communicate participants in teams (and between the teams). There was also a change in the quality and quantity of the solutions proposed in the exercises. A context, exercises and suggested materials used in two-day creativity training were adopted from [8]. This manual constitutes a key set of principles and practice concerning the issues of the training.

At DAY 1 training exercises were focused on developing interpersonal skills which enhance group climate, the communication and cooperation of the students. The exercises in interpersonal skills were aimed for a better understanding of students who are in a team, and to increase team's cohesion by giving it a name and

presentation of the totem (logo) of each team. At this stage, the students were given crayons and large sheets of paper and were asked to draw a character (totem) which will be the symbol of their team as well as come up with unusual names (Indian style) that reflect the most important characteristics. Then the whole group has presented eight works that depicted the totems of each team, and read atypical "Indian" names. Another exercise was to present in the form of non-verbal sculptures (created by all the members of one team). Sculpture purports represented a problem or a defined concept (often abstract). Each of the eight teams presented another problem or concept and the rest of the group was tasked guess this wordless message. The next exercise was creating a common work - drawing, which was presented in the form of simple signs, symbols referred to the current mood of individual team members. The works were presented to the groups. The teams also worked on overcoming the perception and use of the objects. The next two exercises were the motivating group exercises. The first of them was to find as much as possible defects in products; this technique is called reverse brainstorming session. In this case, a person simulated the object and was open to criticism by peer students. The second exercise from this motivation set was aimed for improving the product, namely with the introduction of step-by-step changes at the facility. This time, the members of each team used self-selected object, which was subjected to changes. Teacher merely pointed out that this should be the subject of consumer and well known to all participants in the training.

At DAY 2 of creativity training course, the overarching objective was to develop the capacity for mental operations. Proposed training exercises were abstraction, deductive reasoning, inductive reasoning, making associations, and metaphorising. An exercise to develop abstracting was oriented to stimulation of the imagination and of activation of semantic fields while moving away from stereotypical notions associated with the analysed object. The teams presented such definition of objects (e.g., a lamp, a window, a chair) using language puzzles. The exercise of deductive reasoning was the removing of the proposal for unusual, the output-based state of affairs. In the exercise of inductive reasoning test, teams solved the analogy with the same form of analogy. Metaphorisation exercise consisted of completing sentences in many different ways. This task was aimed, as in the case analogy, to find an accurate description which facilitates understanding of the demanding problem.

The final exercise was a motivational group exercise and contained the elements of crushing, repairing and building. It was necessary to create a project of an ideal city.

The teams were working simultaneously on the project of the settlement for women, men, fun of nature, and chemical sciences fun.

Figure 3. Green city design and a totem of the training group

Since the teams were eight, two teams were parallel assigned to create a project for the same group of people. To perform this exercise, different types of material were used: cardboard and paperboard boxes, colour paper, crayons, plastics pieces and artefacts, metal containers and other items of the daily use. Most of the creations were spatial character and resembled a form of artistic technique which is collage. Presentations of created artefacts and mind models were original and distinctly different from each other (Figure 3). The aims and objectives that guided the training can be carried out as realized.

Methodology

The sample, instruments and data collection and analysis are described in the following subsections.

Sample

The sample was drawn from the freshman chemical engineering students at the Cracow University of Technology (N=100). The students were divided into two groups. The experimental group included creative thinking training participants (N = 49), while students participating in other activities humanistic (N = 51) formed the control group. The study was conducted in the premises of Cracow University of Technology at the end of the summer semester (April and May 2015). In sample were more female (N=78) than male students (N=22).

Instruments

The test for Creative Thinking-Drawing Production (TCT-DP) [16] has been used in this research as pre- and posttest. The TCT-DP test has been already exploited in our previous study and it was proved as a reliable and valid instrument [17]. In this test, subjects take both versions of the test, one after the other. Subjects complete incomplete drawings in any way they like. They may draw whatever they like and how they like: everything is permissible and everything is correct.

When we consider KANH - Creative Behaviour Questionnaire [18], one will find that the questionnaire comes in two versions: KANH-1 for school-aged adolescents and students and KANH-2 for teachers (psychometric parameters have only been tested for KANH-1). Each version consists of 60 items in the form of sentences (in the indicative mood) addressing the respondent's behaviour in situations involving studying and action. The respondent rates the appropriateness of each statement on a three-point scale: true, partly true and false.

Procedure and data analysis

Procedure at TCT-DT test: individual or group administration, testing with one version takes 15 minutes. This examination used first version A. and after B. It should be noted that version B is a mirror image version of A. Applications: for screening (creativity training; as a selective instrument in recruitment to schools or vocations), in individual diagnosis and for research (studies of the nature, development and determinants of creativity and cross-cultural studies). Reliability on pre-and post-test are: Pre-test: Cronbach's alpha = 0.73, Post-test: Cronbach's alpha = 0.76.

Procedure at KAHN surveying: individual or group administration, no time limit. This examination used only version KANH-1. The Creative Behaviour Questionnaire

assesses creative aptitude understood as qualities of the human personality (creative attitude). The outcomes are assessed within four different scales: Conformity (K), Algorithmic behaviour (A) Heuristic behaviour (H) Nonconformity (N). Other indicators can also be calculated, i.e. creative attitude, reproductive attitude, cognition and character. Applications: in counselling to assess creative attitude

Reliability of Cronbach's alpha of KANH survey is 0.61 (n=60 items), what is regarded as weak to moderate internal reliability, shown in Table 1.

Table 1. Reliability information Cronbach' α on KANH subscales

Creative Behaviour Questionnaire KANH	Subscale	Cronbach' α
Reproductive attitude	Conformity (K)	0.52
	Algorithmic behaviour (A)	0.50
Creative attitude	Heuristic behaviour (H)	0.62
	Nonconformity (N)	0.71

The study was divided into two phases and during the conduct used two methods discussed above.

In the first stage at the beginning of the course we asked the respondents from experimental and control groups to perform drawing a Test of Creative Thinking version A. This step was a pre-test. In the second stage at the end of the course after 15 hours (creative thinking training or other activities humanities) again asked the respondents from both groups to perform drawing a Test of Creative Thinking Version B, which was post-test and complete the Creative Behaviour Questionnaire KAHN.

Results

The first most important result obtained compared to the results obtained in the test for Creative Thinking-Drawing Production (TCT-DP) is a distinct difference between pre-test and post-test. Table 2 depicts the average scores on the subscales where is M-mean and SD-standard deviation. All examined students significantly higher scored at post-test than the pre-test in the test for Creative Thinking-Drawing Production (TCT-DP).

Table 2. Paired Samples Statistics-average scores on pre and post-test on TCT-DP

	All Group	M	SD	N
Creative Thinking-Drawing Production (TCT-DP)	Post-test	31.26	12.23	100
	Pre-test	28.41	10.76	100

T-test revealed significantly differences between post- and pre-test where was t(99)=3.22, p=0.002<0.05. The all group of surveyed students (N=100) achieved higher scores in post-test. The obtained result indicates that the screened students showed more creative drawing in the second version B test for Creative Thinking-Drawing Production (TCT-DP). This may indicates on a more flexibility in the way of thinking with the passage of time, and despite of the similarities of tasks.

Levene's Test of equality of variance across groups was performed in advance to ensure the assumption of equal variance was met (F(1,98)=3.697, p=0.057>0.05). While T-test revealed not significant differences in creativity scores between experimental and control group t (98)=-0.845, (p=0.40>0.05). The basic descriptives of creativity gain (a difference between post- and pre-test of TCT-DP) are shown in Table 3. The experimental group gained higher on creativity but differences are not statistically significant (p=0.40 >0.05).

Table 3. Creativity gain descriptives between the experimental group and control group (N=100)

	Group	Number of students	M	SD
TCT-DP test	Control	51	2.11	7.97
	Experimental	49	3.61	9.66

Some significant differences (p<0.05) emerged in the analysis of the dependent variables, which consisted of 14 key assessment criterions (D1-14), used for evaluation of the drawings of the tested students. Analysis of variance revealed statistically significant differences between the groups (p<0.05) at two assessment criterions. At criterion of D12 (Unconventionality-Any usage of symbols or signs) an experimental group scored higher, the effect size is regarded as small (eta squared=0.03) while at criterion of D13 (Unconventionality- Unconventional use of given fragments) a control group scored higher, the effect size is regarded as moderate (eta squared=0.08).

In Figure 4, the results of KAHN survey subscales are depicted. Mean results in subscales (heuristic behaviour and nonconformity) which relate to creative attitudes are higher in both groups compared to the results obtained in forming the attitude of reproductive subscales. Variance test of between-subjects effect across behaviour subscales revealed non-significant differences (p>0.05).

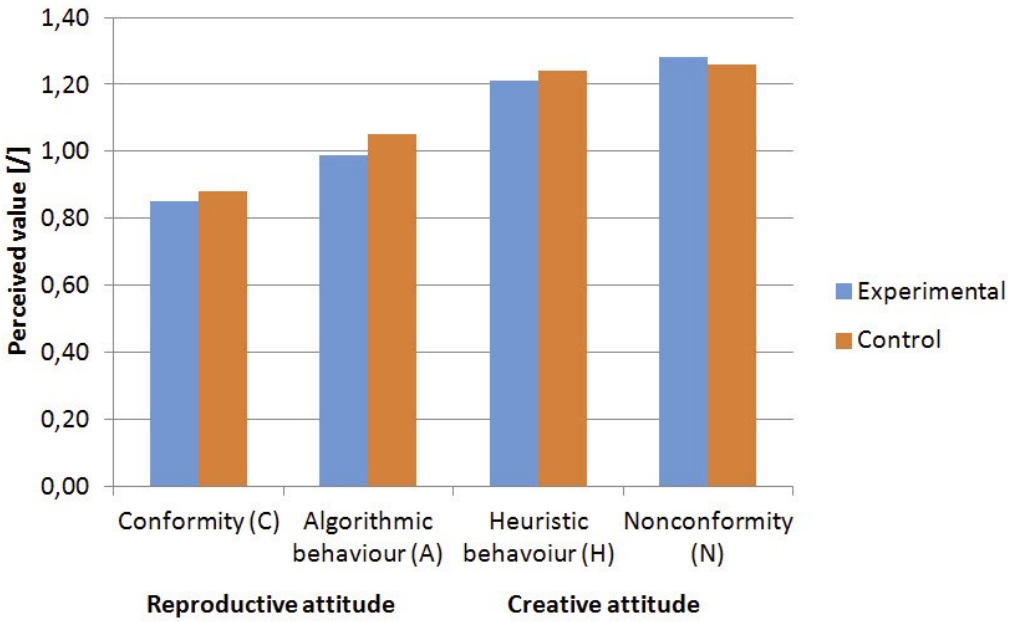

Figure 4. Differences in average results of KAHN survey between the experimental and control group

Conducted multiple regression analysis, a significant difference was found ($p<0.05$). Algorithmic behaviour significantly affects students creativity with negative beta weight (beta = -0.259), Table 4. The learners with prevailing algorithmic behaviour were ranked lower at creativity test than their counterparts. Higher was intensity of algorithmic behaviour; lower was creativity gain after a two-day creative training course for green design.

Table 4. Multiple regression on the subscales of the test KAHN

Creative Behaviour Questionnaire KAHN	Subscale	Unstandardized Coefficients		Standardized Coefficients		
		B	SE_B	*Beta*	*t*	*p*
	(Constant)	19.44	7.41		2.62	0.010
Reproductive attitude	Conformity (K)	-1.49	3.87	-0.044	-0.38	0.702
	Algorithmic behaviour (A)	-9.98	4.21	-0.259	-2.36	0.020
Creative attitude	Heuristic behaviour (H)	-2.50	5.00	-0.073	-0.50	0.617
	Nonconformity (N)	-1.62	4.45	-0.053	-0.36	0.716

Basics descriptives on creativity gain across sex revealed a weak gain in creativeness at male students over female (Mm=3.10, Mf=2.78). Analysis of variance

between groups revealed no statistically significant differences, $F(1)=0.21$, $p=0.88 > 0.05$.

Reported standard deviations of the TCT-DP results are regarded as high, especially those in the experimental group. This indicates that results were widely spread. Some of students were advanced more at creativity training; while some of them were decreasing markedly, perhaps of too much congested training schedule or of articulation phases which were conducted in a two-day training course.

Conclusions

Our research yielded some interesting findings. The results indicate that students at Faculty of Chemical Engineering and Technology achieved higher scores in the post-test Creative Thinking Drawing Production in the whole group. It can therefore be concluded that the test group of students after participating in the activities of a humanist showed a more creative possibilities than at the beginning of classes. This result can be interpreted in two ways. Participation in the faculty of humanities generally has a beneficial effect on the development of creative potential. As a result this may indicate that the 15 periods of training creative thinking perhaps is not enough for full mode of green design development. Thus, a course needs modification in terms of allotted time. In general, an initiative of eco-creative training is regarded as successful. The results show significant differences between the experimental group and control group to analyse detailed evaluation criteria drawings and Creative Questionnaire subscales KAHN behaviour. The number of examined female students was considerably large but there were no differences in behaviour between the sexes creative in the study group. It should, however, refer to the theoretical assumptions, which are included in the introduction. The concept of knowledge is not overt, which assumes that certain issues exist only in the mind of the man who has it. This knowledge is produced as a result of experience and at the same time is not fully conscious. So, given these assumptions, you can count on a delayed effect of the training of creative thinking that can manifest itself greater openness and exploration by students, different ways of solving problems.

Any action that is aimed at developing the creative possibilities entity, and at the same time allows interoperability in the group, it is his actions creative in itself. Developing creative abilities of future engineers is a task that obviously and

unambiguously activates and expands knowledge (explicit and implicit). Although the effects of these interactions can present themselves after a certain time of incubation.

Finally, it must be highlighted that education and training in green engineering and design are the key weapon to tackle the current needs. Green engineering has to be introduced at academic and industrial levels to create a critical mass of engineers and scientists to undertake this challenge as soon as possible.

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3. Green areas

"GREEN" AREAS IN SLOVENE PRIMARY EDUCATION / "ZELENA" PODROČJA V SLOVENSKIH OSNOVNIH ŠOLAH

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Abstract

In the more developed countries of the world have for a long time an important research field of raising awareness about ecology and generally the "green areas". Studies have led, in addition to other contributions to science, to the development of new "green professions", which are important for the encouragement of so-called green economy. The problem arises in the education of existing employees and job seekers, as employers, workers and jobseekers do not have easy access to a deficit of education. Even with this problem, the researchers involved in the project STRENGTH. Project STRENGTH is providing strategic advice in developing green economy strategies, incorporating global best practices and networking in a global network of teaching about the green economy. It analyses global trends in the green economy, with a focus on investments in clean technologies and fiscal instruments to generate efficient use of energy, water and mineral resources, buildings, transport and waste.
To prospective job seekers and prospective employers were willing to advance a green economy, it is necessary to adapt and upgrade existing education, from the beginning (primary school) to the end (higher / university education). In this article we will focus on primary education in Slovenia.

Keywords: green areas, curriculum, primary school

Povzetek

V razvitejših državah po svetu so že dlje časa pomembna raziskovanja področja ozaveščanja ljudi o ekologiji in na splošno o "zelenih področjih". Raziskave so, poleg ostalih prispevkov k znanosti, povzročile razvoj novih "zelenih poklicev", ki so pomembni za spodbudo tako imenovanega zelenega gospodarstva. Problem nastane pri doizobraževanju že zaposlenih in iskalcih zaposlitve, saj delodajalci, delavci in iskalci zaposlitve nimajo enostavnega vpogleda v primanjkljaj izobrazbe. Tudi s tem problemom se ukvarjajo raziskovalci v projektu STRENGTH. Projekt STRENGTH

zagotavlja strateško svetovanje pri oblikovanju strategije zelenega gospodarstva, z vključevanjem globalno najboljših praks in povezovanjem v globalno mrežo poučevanja o zelenem gospodarstvu. Analizira globalne trende v zelenem gospodarstvu, s poudarkom na investiranju v čiste tehnologije in fiskalnih instrumentih za generiranje učinkovite uporabe energije, vode, rudnega bogastva, stavb, transporta in odpadkov.
Da bi bodoči iskalci zaposlitve in bodoči delodajalci bili že vnaprej pripravljeni na zeleno gospodarstvo, je potrebno prilagoditi in nadgraditi obstoječe izobraževanje, in sicer od začetka (osnovne šole) do konca (višje / visoke šole). V tem prispevku se bomo osredotočili na osnovnošolsko izobraževanje v Sloveniji.

Povzetek: zelena področja, predmetnik, osnovna šola

Zeleno gospodarstvo

Ko je govora o zelenem gospodarstvu, se ne da spregledati pojma ekologija. Ekologija je znanstvena veda, ki preučuje porazdelitev in bogastvo živih organizmov in odnose med živimi bitji ter živim in neživim okoljem. Okolje organizma vsebuje njegovo fizično naravno bivališče (habitat), ki se ga lahko opiše z vsoto dejavnikov kot sta podnebje in geologija in tudi drugih organizmov, ki si bivališče delijo. Glede na dejstvo, da civiliziran svet temelji na gospodarstvu, je bilo samo vprašanje časa, kdaj se bomo ljudje začeli zavedati o pomenu zelenega gospodarstva [1].

Po definiciji Programa za okolje ZN, je zeleno gospodarstvo "tisto, ki se kaže v večji blaginji ljudi in socialni pravičnosti, ter hkrati v občutno manjšem tveganju za okolje in pomanjkanju ekoloških dejavnikov". Da bi dosegli njihove temeljne mejnike - nizkoogljična družba, učinkovita raba virov in socialno orientirano gospodarstvo, je potrebna dobro usposobljena in opremljena delovna sila za zelene poklice, ki spodbujajo in realizirajo idejo zelenega gospodarstva skozi praktično uporabo na določenih področjih gospodarskih dejavnosti [2].

Projekt STRENGTH

Aktualni trendi evropske politike nakazujejo potrebo po razvoju gospodarstva, temelječega na znanju. Med pomembnimi dejavniki, ki vplivajo na takšno politiko so: i) staranje prebivalstva; ii) večje povpraševanje po možnostih vseživljenjskega učenja iii) premik iz sistema "znanja" h "kompetencam", in iz "poučevanja" k "učenju". Te spremembe so sprožile zahtevo po nadgradnji znanja in veščin zaposlenih [2].

Projekt STRENGTH si ob uvajanju sinergičnega transferja obstoječega modela sistema usposabljanja (Vocational Qualification Transfer System in Public Health - Transfer sistema poklicnega usposabljanja v javnem zdravstvu) v štirih državah EU - Španiji, Bolgariji, Sloveniji in Angliji, glede na premik na evropskem trgu dela v smeri proti na znanju temelječem gospodarstvu in trajnostnih delovnih mestih, prizadeva za razvoj temeljnih veščin na delovnem mestu v okviru področja kemijske tehnologije, z ohranjanjem zavedanja zelenih sposobnosti [2].

Cilji projekta so usmerjeni na uvajanje koncepta "zelenih sposobnosti", z namenom ustvarjanja novih priložnosti za učitelje poklicnega izobraževanja in usposabljanja (VET) ter sisteme za izgradnjo zelenih veščin zaposljivosti in nadaljnji razvoj ekološke ozaveščenosti pri iskalcih zaposlitve. Na ta način bodo sodelujoči v poklicnem izobraževanju in usposabljanju pridobili znanja za novo generično zaposljivost in zelene veščine za uresničevanje lastnega razvoja, zaposljivosti in nastopanja na evropskem trgu dela [2].

Ekologija v osnovnošolskem izobraževanju na tujem

V svetu je bilo opravljenih več raziskav na temo ekologije v osnovnošolskem izobraževanju. Ena izmed njih je bila tudi raziskava katere namen je bil oceniti vplive izobraževalnega programa o ekologiji na znanje o okolju, okoljevarstvu in odgovornemu ravnanju do okolja osnovnošolskih učencev. Vzorec je zajemal skupno število 64 osnovnošolcev (26 punc in 38 fantov), ki so sodelovali v poletnem izobraževanju o ekologiji v naravi, ki je bilo organizirano v Ankari v letu 2008. Eksperimentalna raziskava je bila zasnovana kot predtest - posttest z eksperimentalno in kontrolno skupino. Za zbiranje podatkov je bila uporabljena serija instrumentov na vzorcu. Kvalitativni podatki so bili podvrženi analizi vsebine medtem, kvantitativni podatki pa so bili analizirani z uporabo ponavljajočega ANCOVA in t-testa. Raziskava je pokazala, da je izobraževalni program o ekologiji, bistveno prispeval k odgovornejšemu obnašanju v okolju osnovnošolskih učencev. Kljub udeležitvi izobraževalnega programa o ekologiji pa je iz primerjave rezultatov predtesta in posttesta razvidno, da program ne vpliva na znanje o okolju osnovnošolskih učencev [3].

Naslednja raziskava je bila izvedena s tremi učitelji naravoslovja in šestimi učenci (tri punce in trije fantje) iz različnih razredov, z namenom da se razišče šolske in obšolske dejavnosti, ki vplivajo na za razvoj ekološke ozaveščenosti učencev. Učenci,

ki so ekološko ozaveščeni bi morali kazati veliko zanimanje in zaskrbljenost nad okoljem in bi morali znati dokazati odgovorno ravnanje pri preprečevanju ekoloških problemov. Rezultati kvalitativne raziskave so pokazali, da učenci niso ekološko ozaveščeni in se ne zavedajo svojega okolja, zaradi pomanjkanja znanja in zanimanja o njem. Raziskava je pokazala, da je, njihovo pomanjkanje ali omejeno poznavanje naravnega okolja in ekoloških problemov in vprašanj, posledica učiteljev, staršev in novic v zvezi z okoljem v medijih. Ti trije viri so glavni elementi, ki prispevajo k ekološki ozaveščenosti učencev, njihovem odnosu do okolja in zavedanju le tega, ter znanju in o ekologiji [4].

Glavni vir ekoloških informacij za učence so učitelji in učbeniki / delovni zvezki učencev. Učitelji, kot izvajalci učnega načrta, imajo pomembno vlogo pri oblikovanju učenčevega ekološkega ozaveščanja in odgovornega vedenja. Učitelji bi, glede na njihovo raven pedagoškega znanja vsebin o ekologiji in na način, kako poučujejo ekološke teme, lahko vplivali na povečanje znanja in zavedanja o ekologiji učencev. Raziskava je pokazala, da učitelji še vedno preveč uporabljajo metodo razlaganja in zastarelega načina preverjanja znanja med razlago (vprašanje - odgovor). Veliko je tem, kjer učenci dosežejo višje kognitivne stopnje s pomočjo v učenca usmerjene metode pouka (student-centered method). Rezultati raziskave kažejo, da je tudi pri poučevanju ekologije potrebno večkrat uporabiti omenjeno metodo za izgradnjo lastnega učenčevega znanja, ki jim lahko pomaga ponotranjiti teme in povečati svojo raven ekološke ozaveščenosti. Poleg tega je raziskava pokazala, da izvedba številnih dejavnosti v šoli in izven šole pripomorejo k razvoju ekološke ozaveščenosti učencev [4].

Na svetovni konferenci, na temo izobraževanja, z naslovom *World Conference on Education for All - Meeting Basic Learning Needs* je bila ena od tem tudi "Okoljsko izobraževanje: Komponenta trajnostnega razvoja", kjer so bile predstavljene tudi smernice, ki služijo v pomoč pri izboljšanja stanja učenčeve ekološke ozaveščenosti. Avtorja prispevka predpostavljata, da se lahko povečajo možnosti, da se spremeni učenčevo zavedanje na okoljsko dimenzijo, če bodo izobraževalne ustanove:

1. učile okoljsko pomembne ekološke koncepte in okoljske medsebojne povezave, ki obstajajo znotraj in med temi koncepti;
2. zagotovile skrbno načrtovane in poglobljene priložnosti za učence, da dosežejo neko raven okoljske občutljivosti, ki bo spodbujala željo, da se obnašajo na primeren način;

3. zagotovile učni načrt, katerega rezultat bo poglobljeno znanje o težavah;
4. zagotovile učni načrt, ki bo učence naučil veščine analize težav in preiskave, kakor tudi zagotovil potreben čas za uporabo teh znanj in spretnosti;
5. zagotovile učni načrt, ki bo učence naučil veščin državljanstva, ki so potrebni za izdajo sanacije, kot tudi čas, ki je potreben za uporabo teh znanj in spretnosti; in
6. zagotovile način poučevanja, ki povečuje učenčevo notranjo motivacijo, da v določenih situacijah deluje na odgovoren način, tj poskušali razviti notranji fokus kontrole v učencu [5].

Ekologija v osnovnošolskem izobraževanju na slovenskem

Ko je govora o slovenskih osnovnih šolah (OŠ) in o "zelenih" področjih, ne gre spregledati mednarodnega programa Ekošole (Eco-Schools), v katerega je vključenih veliko število slovenskih osnovnih šol. Program Ekošola je mednarodno uveljavljen program celostne okoljske vzgoje in izobraževanja, namenjen spodbujanju in večanju ozaveščenosti o trajnostnem razvoju med otroki, učenci in dijaki skozi njihov vzgojni in izobraževalni program ter skozi aktivno udejstvovanje v lokalni skupnosti in širše. Vsako leto so najuspešnejšim šolam podeljena mednarodna priznanja - zelene zastave. To je tudi edino javno in mednarodno priznanje slovenskim šolam za okoljevarstveno delovanje, skladno z mednarodnimi kriteriji FEE (Foundation for Environmental Education) [6].

Ena izmed šol, ki so vključene v projekt Ekošola je tudi OŠ Vižmarje Brod (Slika 1), ki ima v šolskem letu 2015 / 2016 v sklopu Ekošole izpeljati več projektov na temo ekologije: Ohranjanje biotske pestrosti, Zdravo življenje, Voda in Ravnanje z odpadki, kamor spada več dejavnosti (Eko dan in ozaveščevalna akcija, Ekobralna značka, Natečaj voščilnic, Zbiranje izrabljenih tonerjev in kartuš, Zbiralna akcija odsluženih električnih aparatov in elektronskih odpadkov, Ekokviz za OŠ, Mladi reporter - prispevki za objavo in Zbiralna akcija papirja [7].

Slika 1. Ekodan na osnovni šoli [7]

Na OŠ 8 talcev Logatec so v sklopu Ekošole na praznik dneva Zemlje urejali sprehajalno pot pod Sekirico (Slika 2) [8].

Slika 2. Dan Zemlje na osnovni šoli [8]

Na OŠ IV Murska Sobota so v okviru Ekošole pri pouku tehnike in tehnologije z učiteljem, učenci višjih razredov in oddelkov vzgoje in izobraževanja izdelali visoko gredo, jo postavili ter naredili plasti po pravilih za visoke grede (Slika 3) [6].

Slika 3. Izdelava visoke grede pri pouku TIT [6]

V slovenskih OŠ se učenci na predmetni stopnji spoznajo s pojmom ekologije pri več obveznih predmetih, med katerimi nekateri zajemajo snov v obveznih vsebinah učnih načrtov, nekateri pa imajo znotraj vsebin povezavo ciljev na to temo.

Predmeti in nekatere vsebine, pri katerih, po pregledu učnih načrtov, učitelji lahko povezujejo cilje na temo ekologije so:

- FIZIKA: *Fizika in okolje: Fizikalna dognanja nam lajšajo življenje*

Učitelj samostojno ali skupaj z učenci izmed tem, kot so npr. nekatere izbirne vsebine, fizikalno zgodovinske teme, teme v zvezi s sodobnimi odkritji ali opisom sodobnih naprav (GPS, mobilna telefonija, polprevodniki, računalniki, laserji, tekoči kristali, optična vlakna, jedrske elektrarne, pospeševalniki, nanotehnologija, ekologija itd.), izbere tisto, za katero meni, da bo učence zanimala, in z njo zaokroži pouk fizike v osnovni šoli [9].

- GEOGRAFIJA: *Obsredozemske pokrajine*

Učenec na zgledu koprskega pristanišča opiše pomen pristanišča za Slovenijo in izpostavi z njim povezana ekološka vprašanja [10].

Predmeti, ki, po pregledu učnih načrtov, vsebujejo ekološke teme in pri katerih se učitelji morajo posluževati ekoloških tem tekom celotnega izvajanja predmeta so:

- GOSPODINJSTVO:

Osnovnošolski predmet gospodinjstvo pokriva več disciplin družboslovnega in naravoslovnega področja. Predmet omogoča razumevanje vloge posameznika in družine oziroma gospodinjstev v družbi. Pouk gospodinjstva učence spodbuja k razmišljanju o povezujočih problemih časa in k vključevanju v reševanje vprašanj posameznika, družine in družbe. Pri predmetu gospodinjstvo učenci pridobivajo znanja, veščine in spretnosti za čim bolj gospodarno izrabo virov v naravi in družbi, potrebnih za zadovoljevanje osnovnih življenjskih potreb. Pri gospodinjstvu se, poleg ostalih temeljnih načel, ki jih upoštevajo pri uresničevanju splošnih ciljev, držijo načela ekološkosti. To načelo uresničujejo z razvijanjem odgovornosti za vzdrževanje in ohranjanje človekovega bližnjega in daljnega okolja ter z razvijanjem odgovornosti do osnovnih prostih dobrin: vode, zraka in zemlje. Pri modulu *Bivanje in okolje* imajo več tem, ki so povezane z ekologijo, kot je na primer *Ekološko osveščen potrošnik*. Predmet gospodinjstvo zajema tudi tematski sklop *Ekološka poraba*, kjer zajamejo veliko pomembnih področij ekologije [11].

- TEHNIKA IN TEHNOLOGIJA:

Pri predmetu tehnike in tehnologije mora učitelj opozarjati na pomen ekološkega ozaveščanja učencev in jih stalno opozarjati na vplive gospodarstva in civilizacije na okolje. V učnem načrtu so poleg ciljev navedeni tudi standardi znanja s področja ekologije, ki jih mora učenec v OŠ doseči do zaključka predmeta, kot so:

6. razred:	• učenec razlikuje med recikliranim in navadnim papirjem; • učenec utemelji pomen ekološko neoporečne proizvodnje papirja; • učenec pojasni smisel zbiranja odpadnega papirja; • učenec razloži pomen embalaže za shranjevanje predmetov in snovi, za transport in trženje z vidika tržnih zakonitosti ter jo ovrednotiti z ekološkega vidika; • učenec z gospodarskega in ekološkega vidika razloži vpliv gozda na okolje; • razloži namembnost lesnih premazov in utemelji prednosti ekološko prijaznih premazov.

7. razred:	• učenec utemelji vlogo človekovega dela in odgovornosti pri nepravilnem spreminjanju narave; • učenec pojasni vpliv proizvodnje in uporabe umetnih snovi na okolje; • učenec opiše alternativne vire in načine pridobivanja električne energije.
8. razred:	• učenec pozna vpliv proizvodnje kovinskih predmetov in njihove uporabe na okolje; • učenec razloži pomen recikliranja; • učenec opiše vpliv množične uporabe motornih prevoznih sredstev na spremembe v okolju [12].

- KEMIJA:

Pri predmetu kemije sicer ni velikega poudarka na "zelena" področja, je pa vseeno zajeto, in sicer pri vsebinskem sklopu *Družina ogljikovodikov s polimeri*, kjer je eden izmed operativnih ciljev tudi, da učenci razmišljajo o preprečevanju oziroma zmanjševanju vplivov ogljikovodikov in njihovih derivatov na okolje in se zavedajo pomena recikliranja odpadkov. V sklopu didaktičnih priporočil, v poglavju *Kemijska varnost* je omenjena ustreznost odstranjevanja odpadnih snovi [13]. Glede na vsebino in eksperimente, ki se izvajajo pri pouku kemije, bi bilo smotrno vključiti več snovi na temo ločevanja odpadkov in ravnanja z nevarnimi snovmi. V industrijskih obratih so kemijski laboratoriji zelo pomembni in bi zato tej temi ravno tako lahko namenili večjo pozornost.

Rezultati in zaključek

Glede na pregledano literaturo o izobraževanju na temo ekologije v slovenskih in tujih osnovnih šolah je bilo ugotovljeno, da je v slovenskih osnovnih šolah dovolj predmetov, ki zajemajo teme ekologije, vendar bi se bilo potrebno poglobiti v t.i. zelene poklice. V nobenem učnem načrtu ni bilo moč zaslediti ciljev predmeta, ki bi zahteval znanje o poklicih, ki so pomembni za zmanjševanje onesnaževanja ali katerikoli poklici, ki so tesno povezani z ekološkimi problemi.

Projekt STRENGTH je v Sloveniji pričel z zelo pomembno nalogo, ki bi jo bilo potrebno izvajati in razširiti tudi na obvezno osnovnošolsko izobraževanje. V OŠ sicer obstaja izbirni predmet v *Okoljska vzgoja*, ki temelji na spodbujanju "okoljske pismenosti", ki naj bi jo glede na naraščajoče okoljske probleme našega planeta pridobili vsi državljani, vendar to ne zadostuje.

Lahko bi se razvil nov predmet *bodoča zaposlitev*, pri katerem bi se ukvarjali izključno z obstoječimi in bodočimi interesantnimi poklici, med katere nedvomno spadajo "zeleni" poklici. Večina učencev ob koncu OŠ ne vedo, kje bi bili radi zaposleni, ko odrastejo. Če bi imeli možnost obiskovati predmet, kjer bi se celo šolsko leto posvečali le tej temi, bi le to verjetno pripomoglo k boljšim izbiram srednjih šol in kasneje poklicev oz. nadaljnjega šolanja.

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HOW CAN A TECHNOLOGY TEACHER HELP STUDENTS GAIN SOME COMPETENCES NEEDED FOR A FUTURE GREEN JOB?

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Abstract

With increasing unemployment, green jobs are an opportunity for many young students. Every green job needs some competences and qualifications. What competences are needed for a particular green job and how we can gain them can be found using a competence profiler. But can a technology teacher in primary education help to gain some parts of competences needed? I think he can by informing students about recycling different materials and showing them in practice how recycling is done.

Keywords: green jobs, green economy, green competences, recycling, primary school

Introduction

Green jobs are something that young people should consider. A "green" economy nowadays generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and natural resources [1]. The basic question for a certain green job is which competences and qualifications do we absolutely need. One way of finding out is to use a competence profiler developed under the STRENGTH project [2]. The STRENGTH project is currently focused on the Chemical Engineering field, but the model can be adapted to other fields as well. In this article I will try to show that a teacher of technology in primary education can contribute to students' knowledge in order to gain some competences needed for green jobs.

Recycling materials in compulsory basic education

A teacher of technology has direct contact with generations of kids. This is a great opportunity to teach them about different materials, their properties and last but not

least, how we can recycle them. In Slovenia children have technology classes (*tehnika in tehnologija*) from the 6th to the 8th grade. In every grade a different material is the main subject; in the 6th grade paper and wood, in the 7th plastics and in the 8th metals. Within different grades recycling of those materials can be explained.

Recycling paper within technology classes in the 6th grade

In technology classes in the sixth grade of primary education in Slovenia one of main subjects is paper. There is a tradition in Slovenia to collect paper for recycling. Many Slovenian schools at least once a year organize collecting of old paper. During classes students learn about manufacturing paper, different paper types and what are the basic properties of this material. They also learn how homemade paper can be produced from old paper with a simple procedure: tear paper into small pieces, then add a lot of water, some drops of color and starch, and mix everything with a hand mixer. After drying and compacting handmade paper is created. Students can easily understand how paper is recycled. In art classes with laminating paper into many layers students create quite solid paper statues. With reshaping different properties can be achieved. In this way students can understand how we change the properties of materials. These basic concepts of recycling are needed to gain green skills [2].

Recycling plastics within technology classes in the 7th grade

In the seventh grade one of the main subjects is plastic (*umetne snovi*). When different plastics are presented, information about recycling can also be provided. For example Bakelite is difficult to recycle after use [3], PE (Poly Ethylene) can easily be recycled, while PVC (Polyvinyl chloride) is less appropriate, especially in composite form [4]. In chemistry lessons students also learn about chemical structure of these and other compounds, so they can more easily understand that they have different physical and chemical properties.

Examining different machines and equipment can lead to a discussion with students about which parts can and which can't be recycled. A teacher can advise them, how we can reuse plastic packaging for storing different foods, smaller parts, writing accessories etc. It is important to make students aware that some types of plastics can be used for food storage, i.e. PE, while others are not appropriate, i.e. PVC. PVC uses organotin compounds as stabilizers, which are toxic [5]. In this way they can understand that recycling is not an easy task.

Students in Slovenia usually buy and use a pre-prepared box of materials [6]. One of the projects within the box uses plastic granules. It is used to make simple pendant for keys. Granules of PE are inserted into the mold and then heated at a temperature of around 140°C. After cooling down pendants of different shapes and colors can be made (Figure 1). When granules are melted a disgusting smell is produced. So sometimes green is not green in all aspects. Even in the process of recycling we must take care of people and the environment. With such projects students can easily be introduced to recycling of plastic and problems related to it.

Figure 1. Pendants of different shapes and colors can be made from plastic granules

After years of teaching, I have realized that before pendant project students know that recycling of plastic exists but did not really understand it. The project changes this and hopefully forces them to think about recycling and to take even more care of waste in everyday life. During other projects like in Figure 2 students can learn how to transform plastic into different shapes, how to drill, grind and glue them. In this way they can find ideas to use waste plastics without melting. All such experience with plastics can provide a part of competences needed for a future green job.

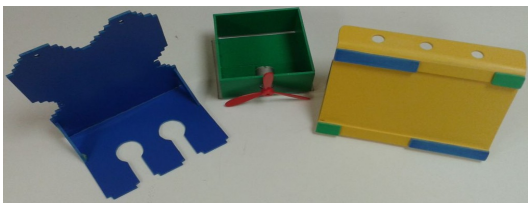

Figure 2. Some projects that students made from plastics

Recycling metals within technology classes in the 8th grade

In the 8th grade students also use a pre- prepared box of materials, this time with different types of metal plates. The main project of the lessons is to build a balloon

compressor. Another project is to create an evaporator for etheric oils from copper and aluminium plates (Figure 3).

Figure 3. Evaporator for etheric oils made from copper and aluminium plates

In this process only a part of the whole metal plate is used. Bigger parts of waste copper and aluminium plates are collected and spared for future projects. Smaller parts are collected in a big plastic box (Figure 4), which is then transported to a company that deals with waste metals. In this way almost nothing is thrown away.

Figure 4. Plastic boxes for collecting waste metals

It is important to make students aware that producing metals from ore is hard and energy consuming. In this way they become aware of the importance of metal recycling, and also an opportunity to create other projects with metals they left. Many green jobs are associated with metal recycling [7], among them those in automotive industry are the most known.

Recycling metals within extracurricular activity

In our school we have many extracurricular activities, one of them is purely technical called *Tehniška raziskovalnica*. Within the lessons students can be creative and create their own projects. At the beginning of the school year we first take apart different electronic equipment, i.e. old or broken computers (Figure 5), printers, TV sets, telephones etc. During the process, students learn about electronic parts, how they are connected with motors, lights (mostly light emitting diodes), power supply and other important parts. They collect different bolts, nuts, washers, sprockets, wires, and electronic parts like diodes, capacitors, transistors, heat sinks, DC adapters. Collected material is then used in different projects. All metal and plastic parts that are not useful to us are collected in already mentioned plastic boxes for recycling. With such a process the knowledge of recycling electronic equipment is gained.

Figure 5. Old broken computer as a source of useful materials for an extracurricular activity

Using parts of old machines within extracurricular activity projects

And how do we use collected parts? Every year participants of the activity decide what project they are going to make. Usually we try to use as many collected wood plates, plastics and metals as we can. The main reason is that they are quickly available and of course we don't have to buy them. During the years many different interesting projects were created.

One of them was a bird house (Figure 6). At first a student took apart an old computer. He used only the front cover as the front plate of the house, other parts of the computer were collected for other projects. On the sides he glued some plywood plates left by students of the 6th grade. At the back of the house, he used brass sticks left by the students of the 8th grade. The house was covered with a removable PE plate left by the 7th grade students. So for only used parts were needed in this project. Among many other bird houses created from waste materials our student's house was awarded [8].

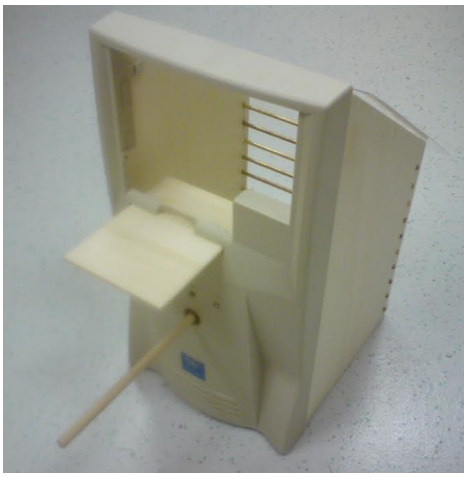

Figure 6. A bird house from collected old materials

In such projects not only the student learns how to reuse waste materials in a creative way, but also his friends and colleagues. Maybe some of them were inspired for a future green job.

Conclusion

A teacher in primary education can do a lot in informing students about recycling and help gain some competences needed for future green jobs. With increasing unemployment the study of such fields may insure a future job, and that is a good opportunity for many young students. Such jobs are also good for the environment, so we as society can all benefit a lot.

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ENVIRONMENTAL EDUCATION AND TRAINING USING INQUIRY-BASED LEARNING

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Abstract

Inquiry-based learning (IBL) as inductive teaching method has originated in late 1960's. IBL is student centred learning process where teacher is only a mentor / instructor and offers help when is needed. Individuals actively construct their knowledge by solving real and authentic problems and searching appropriate information. Students build their knowledge on the base of their prior knowledge using critical thinking, reasoning and problem solving skills. The role of teacher is very important at giving correct feedback. Project STRENGTH focuses on different green competence areas where acquiring of green competences considers knowledge, skills and wider competences. This paper is focused on environmental, health and safety area with a central impact of environmental education. In Primary and Secondary education students familiarize with green competences, but to a lesser extent. Project Chain Reaction makes effort to promote and to exploit IBL method to science and technology including teaching green topics. Since 2013 Faculty of Education at University of Ljubljana organizes teaching and learning of green subject matter designed for a three-day activity open learning course. Courses are aimed for learning of environmental protection and of renewable energy sources. Students were tasked with one of the following topics, namely: water turbine optimization, green heating, plants in space and smart electric car. The sample of study consists of 250 eighth- and ninth-grade students. IBL was guided by modified 5E learning cycle model, where students' satisfaction with IBL was assessed when learning was accomplished.

Keywords: inquiry based learning, technology days, green competences, students' attitude

Introduction

A “green” economy (smart energy & environment) generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency,

reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources [1]. The green economy offers enormous opportunities for job creation, many of which are already underway in the European economy. These opportunities range from sectors traditionally associated with an environmental content - such as renewable energies or recycling - to other activities that represent emerging sectors in green jobs - such as sustainable mobility - and to activities in "established sectors" which have potential for conversion into sustainable activities. The importance of emerging green sectors can be seen in the additional benefits they have brought to the European region [1].

There are many ways to define "green" or the "green economy". The following definition is condensed from the many definitions that have been offered. Common terms and concepts are evident in each of these definitions. For example, the words renewable, sustainable, education, compliance, and efficiency are used by all organizations.

The world strongest / most competitive economy of USA defines green economy activity as [2]:

Green or clean is any activity or service that performs at least one of the following:

- ***G****enerating and storing renewable energy,*
- ***R****ecycling existing materials,*
- ***E****nergy efficient product manufacturing, distribution, construction, installation, and maintenance,*
- ***Education, compliance and awareness,***
- ***N****atural and sustainable product manufacturing.*

A very important green activity concerns with Education, compliance, and awareness. This sector includes [2]:

- Education and Training providers for curricula such as solar panel installation, photovoltaic, renewables, energy auditing, sustainability management, and environmental careers.
- Environmental consulting

- Governmental / legislative compliance
- Conservation and wildlife programs
- Trading and offsets
- Social assistance.

A Green Job is an occupation that 1) directly works with policies, information, materials, and / or technologies that contribute to minimizing impact, and 2) requires specialized knowledge, skills, training, or experience in these areas [2].

Green jobs in Slovenia are not systematically monitored and are not defined. Most green jobs in Slovenia caused by only five factors: renewable energy, energy-efficient construction, waste collection and waste water management, organic farming, and public transport.

Nowadays, more and more students are educating and training for green jobs career. Number of narrowly defined green jobs number in Slovenia is very low. Green jobs in total are about 7250, what present just 1% of total employment, number of widely-defined green jobs but relatively comparable with other developed countries is 2% of total employment. A negative growth rate of general employment in Slovenia is indicated and has to be considered for future green jobs evolution [3]. Majority of the new green jobs are generated in sectors such as alternative energy sources, construction, centred primarily in the construction of energy efficient buildings (increase energy efficiency), transportation both in terms of car production to alternative energy sources, as well as an improvement in fuel efficiency, production and recycling eco-friendly products and agriculture and forestry, especially in the direction of sustainable development [4]. It is worth to highlight in this context.

Green restructuring generates demand for new skills as existing producers' reorientation activities towards new markets and products. Generally, skills needs are reflected in demand for additional competences of existing workers. Greening occupations also raises demand for new competences. While this is especially significant in the energy sector as a result of major investment and expansion in renewables and energy management subsectors (giving rise to new occupations), the main need is to revise and upgrade the skills of existing workers. These new environmentally driven competences relate to new technologies (such as solar power

for electricity and heating, new vehicles on solar power, waste management, renewables exploitation) [1].

The European Union's new strategy for sustainable growth and jobs, Europe 2020, puts innovation and green growth at the heart of its blueprint for competitiveness. However, there are no explicit overarching national strategies targeting green skills needs [5]. Some Member States are moving faster than others to rectify this, with France launching its recent mobilisation plan for green jobs, and the UK government recently launching a consultation exercise, entitled Meeting the low carbon skills challenge. The EU suffers from systemic weaknesses in its skills base which limit its productivity and competitiveness in today's economy, and reduce its capacity to exploit the opportunities offered by green growth. These deficits in management skills and technical job-specific skills (many of which are related to science, technology, engineering and mathematics are a greater concern than shortages of "new" green skills [5].

Young population in Slovenia has very low interest for enrolment in upper secondary vocational education and training (VET) programmes (STE - secondary technical education; VTE - vocational technical education; SVE - secondary vocational education). A constant drop of enrolment was identified from 15.8% population in 2007 / 2008 to 11.7% in the year 2011 / 2012. This drop is particularly noticeable in occupations of construction sector (e.g., only 4 bricklayers and 6 carpenters started the initial education in 2011) while the enrolment in the programmes of mechanical technician and fitter of mechanical installations dropped only moderately. The upgrade of curricula in initial VET is important but it cannot have a major impact on improvement of Energy Efficiency (EE) competences of blue collar workers that are on the labour market.

European Commission runs several activities and initiatives to promote Science and Technology subject matter, also considering green competences. One of them is a Chain reaction project of the Seventh frame program. As a core partner in this project, Faculty of Education at university of Ljubljana is involved since 2013. The project lasts for three years and covers several European countries (UK, Italy, Slovakia, Bulgaria, France, Germany, Greece, and Ireland) and Jordan, Turkey and Georgia. The purpose of the project is to confirm the IBL as an effective method for teaching Science and Technology. Learning content includes environmental education, science and technology. Students learn and develop attitude toward environment and renewable

energy sources. Furthermore, students develop a variety of skills which include problem-solving skills, teamwork, organization, communication and research [6]. In school year of 2013 / 2014, a three-day course was implemented at five secondary schools around Slovenia where eighth- and ninth grade students were recruited. A course format engaged five periods of IBL a day. At each school four green topics were performed, namely: Green heating, Plants in space, Water turbine and Smart electric car.

This paper presents the research which was carried out under the project Chain Reaction. The purpose of the research was to determine students' satisfaction toward the IBL and green subject matters. Perceived students' satisfaction is one of the measures of course quality and green competences acquiring [7].

Inquiry-based learning

IBL is constructivist and student-centred teaching method where participants actively construct their knowledge [8]. IBL is process in which students poses a questions, develop an experiment, collect and analyses data, answer the question, and present the results [9]. Method inspires students to engage in an authentic scientific discovery process. Method is useful at all levels of formal education, from Primary to Secondary school and universities. This method can be applied flexibly across different educational contexts. Tasks, designed to provide inquiry, include problem which students have to solve it. Students work collaboratively and co-operatively with peers [10]. IBL begins when students are presented with questions to be answered and problems to be solved [11]. IBL emphasises higher order thinking skills, critical thinking and problem-solving skills which are more important than simply knowing the content itself. It develops logical thinking skills, responsibility for learning and critical thinking. The teacher, who has very important role in learning process of IBL, helps students to learn the cognitive skills needed for the inquiry, problem solving and collaboration. The teacher serves as facilitator, working with student groups and help students to make connections between their ideas and relate these to important scientific concepts and methods. Students are self-directed and managing their learning goals and strategies but they are not left alone in their discovery. They are guided by a teacher who supports them [10, 11]. The method involves students discussing questions and solving problems in class, with much of the work being done by students working in groups [11].

In the literature, there are several types of IBL which differentiate depending on the levels of inquiry [10, 11, 12]:

- Confirmation inquiry-teacher provide tasks, questions and procedure for solving problems.
- Structured inquiry-teacher give a problem to students and an outline for how to solve it.
- Guided inquiry- teacher give a problem, students have to figure out the solution method.
- Open inquiry-students formulate the problems and search for solutions.

Activities and materials have to be close to the students. This facilitates students to learn through inquiry. Success of IBL is guarantee if activities of IBL are based on the skills level of the students. In this process, students often carry out a self-directed, partly inductive and partly deductive learning process by doing experiments [12, 13].

Instruction in IBL begins with content and experiences likely to be familiar to the students, so they can make connections to their existing knowledge structures. New material should be presented in the context as real-world applications. Instruction should involve students working together in small groups [11]. Several meta-analyses conclude that IBL is more effective than traditional instruction. IBL improves academic achievement, critical thinking skills, laboratory skills and cognitive learning outcomes, which includes conceptual and subject learning, reasoning ability, and creativity [11].

IBL is applicable at all levels of formal and non-formal education and training, from infant schools to universities, and takes place in informal as well as formal learning contexts. Inquiry learning can be applied flexibly across different educational contexts, across all academic disciplines. There is no single design protocol and teaching strategies vary. However, the fundamental point of departure is always an authentic question or problem that may be formulated by students themselves, their teachers, or others. Tasks designed to provide a framework for inquiry include problem or case scenarios, field-work investigations, experiential learning projects and laboratory experiments as well as research projects of various kinds. Students' inquiries may be small or large in scale, involving whole-cycle research projects or only specific elements of a larger research process. Often working collaboratively or co-operatively with peers, sometimes in partnership with teachers, students are

supported by teachers and others with specialist educational roles (e.g., role models, learning technologists) to apply the scholarly and research techniques of their academic or professional discipline [10].

Green technology days

In Slovenia, children aged 6-15 attend nine years of compulsory primary school education. This is divided into two levels: the primary level for children aged 6-11 and lower secondary school for children aged 12-15. Students at Secondary school mostly acquire technology / engineering-related green competences using traditional instruction at Design and technology and Physics subject matter. Beside this, there are several summer schools and camps which offer an excellent opportunity to learn about green technology and other environmental issues. In Slovenia, we have also the possibility that similar content can be introduced through compulsory technology days. Since 1999, these activities have been integrated into all grades of the primary school curriculum. Three technology days are scheduled for the first triad, and four days for the successive triads in each school year. Each technology day has five periods of 45 minutes each, which cover elective topical content from the field of technology / engineering education. These activities have no specific learning objectives verified by a teacher, but play an important role in terms of integration of cross-curricular skills and upgrading students' knowledge with practical experiences [14].

On the other hand, technology days are also aimed to conduct active teaching / learning of those topics which claim more time for entire learning cycle. Active and constructivist approaches (e.g., project-based learning, experiential learning, and research-based learning) are very often conducted through technology days.

In our study, school technology days were carried out on the basis of IBL; all activities were aligned with 5E model which covers five phases [8, 15]:

1. **Engagement:** Teacher helps students become engaged in a new concept using short activities that promote curiosity and elicit a prior knowledge. The activity make connections between past and present learning experience, organize students' thinking and expose prior conceptions [15]. At the school activity days teacher assessed students' prior knowledge and motivated students. Teacher presented problem statement and research questions.

2. **Exploration:** Exploration experiences provide students with a common base of activities. Students generate new ideas, explore questions and possibilities, and design an investigation [16]. At the school activity day students in this phase looking for evidence and ideas with brainstorm 635 method.
3. **Explanation:** Student's attention is focused on a particular part of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding and process skills. Learners explain their understanding of the concept [15]. At the school activity days students testing hypothesis and ideas from exploration phase. After that, students construct scientific knowledge.
4. **Elaboration:** Students develop deeper and broader understanding, more information, and adequate skills through new experience. Students apply their understanding of the concept [15]. At the school activity day students in this phase resolved misconceptions and pitfalls. Students had to write reports and present to their teachers and other students.
5. **Evaluation:** Students assess their understanding and abilities. Teachers evaluate student progress [15]. At the school activity days in evaluation phase students make a reflection at their work and assess their progress.

This 5E model of IBL was used at each green topic which will be described in continuation.

SMART ELECTRIC CAR. The use of electric vehicle is increasingly growing, so it is important that students become familiar with this topic. Students composed cars with Fischertechnik (Figure 1). They combined electrical, mechanical engineering, and computer science. Students in pairs made their model of mobile robot, where checked the use of different sensors. After that, every student proposes solution to increase efficient use of electric vehicle, especially in the field of various options to charge the battery. Then, in group of five, students produced their solution for filling battery electric car. Students presented their solutions to their classmates [14].

WATER TURBINE. The learning process based on the work in small groups of 3-4 students. Students were investigating existing water turbine models and then conceiving parameter of turbine to achieve the best efficiency. Parameters were different: blade cross section, diameter, number of blades, angle between blades, and blade size. Students created their model of a turbine with their key parameter, other

parameters were constant. Groups tested their turbines and wrote results (Figure 2). After stabilisation of understanding, each group wrote a final report [10].

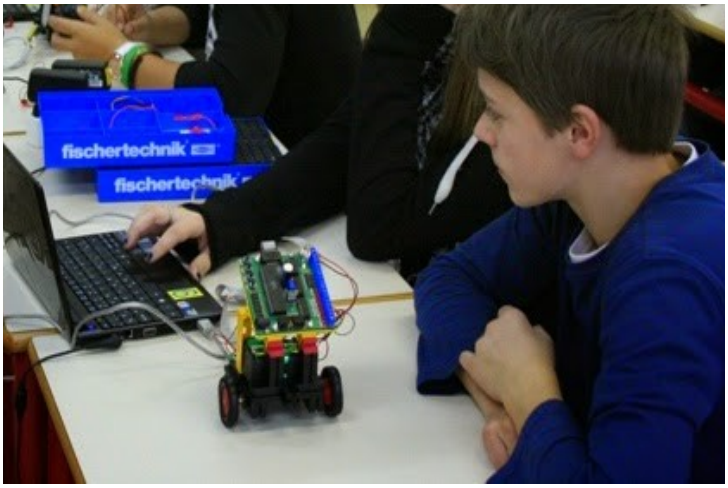

Figure 1. Smart electric car

Figure 2. Water turbine

GREEN HEATING. Students carried out simple investigations to find out which colour and type of surface is best for absorbing infrared radiation so that it can be used in a solar panel (Figure 3). Before investigation, students were given information about solar panels and about infrared radiation from the Sun. The teacher should issue the students with the Student Activity Sheet which also acts as a checklist so that they

can monitor their progress; then hand out Green Heating to the students. This gives information about how solar panels use infrared radiation from the Sun to heat up water. The Activity requires students to carry out an investigation concerned with the type of surface that absorbs infrared radiation best. At the beginning of investigation students should submit their plans for approval and they carried out the investigation. They analysed evidence in groups, wrote conclusions and evaluated evidence.

Figure 3. Green heating

PLANTS IN SPACE. Students were asked to carry out investigations into various aspects of photosynthesis, to work out what plants could best be used in the life-support system, and into human physiology to work out what needs a crew would have for oxygen and food on the journey (Figure 4).

Figure 4. Plants in space

A note at the end of the Student Activity Sheet asks for any further suggestions for investigative work. Students may suggest testing a range of food plants to see which ones are the most efficient at photosynthesising. This may not produce conclusive results, but it could be a worthwhile experiment to try - if only to show that sometimes scientists do not get definite answers. One possible approach would be to illuminate various food plant leaves (as fresh as possible) in a closed environment with a CO2 indicator.

Methodology

The sample, instrumentation, and procedure of data collection and analysis are described in the following sections.

Sample

The sample in this study was drawn from Lower secondary school students and comprised 260 eight- and ninth grade students aged 13-14. Gender was nearly evenly distributed with 53.8% females and 46.2% males. School activity days were carried out at five Slovenian schools (Table 1).

Table 1. Schools information and students' distribution

School name	Percentage of participants	Number of students
OŠ Ketteje in Murna, Ljubljana	16.9 %	44
OŠ Mokronog	16.5 %	43
OŠ Ivana Cankarja, Vrhnika	19.6 %	51
OŠ Antona Tomaža Linharta, Radovljica	20.8 %	54
OŠ Davorina Jenka, Cerklje na Gorenjskem	26.2 %	68

Students were randomly tasked with one of four topics (Table 2).

Table 2. Students' distribution across green topics

Green topic	Percentage of participants	Number of students
Plants in space	16.2 %	42
Water turbine	25.0 %	65
Smart electric car	25.8 %	67
Green heating	33.1 %	86

Lower secondary schools recruited in this study were carefully selected by role models (university scientist, applied science researchers, or young researchers) in order to explore of possibilities of project Chain Reaction outcomes and results exploitation.

Instrument

After school activity day students solved questionnaire which has been drawn up with 13 questions [16, 17]. These questions have been arranged into five categories:

1. **Physical learning environment** (suitability, user-friendly, and comfort of equipment)
2. **Teaching materials** (quantity of information, modernity of materials)
3. **Learning process** (balance of independent work, co-operation and assistance, needed aid quantity, clarity of instructions and explanations)
4. **Reactions** (satisfaction with acquired knowledge, option of their own creativity, recommending a method of work to others)
5. **Content** (contemporary, attractive, clear and readable, organized)

Students are evaluated on a continuous scale from 1 to 7, where means 1-minimum and 7-maximum. At the beginning were also two demographic questions about gender, and the age of students, re-attendance at the school activity day. The test items were validated by an expert panel.

Procedure and data analysis

Students were surveyed once, as post-test, used a paper / pencil method after IBL. A teacher was present in the class during a survey. The data were analyzed with IBM SPSS. The basic tools of descriptive statistics, analysis of variance ANOVA and MANOVA were used. Internal consistency of the instrument was checked with method of Cronbach's alpha.

Results

Internal consistency of the items is regarded as high, which shows Cronbach's $\alpha = 0.91 > 0.60$ [10]. Students were satisfied with school activity day and teaching method. General satisfaction scores are expressed with M-mean and SD-standard deviation (5.36; 1.19; accordingly).

Figure 5 shows students satisfaction with IBL of green subject matters. Students were the most satisfied with learning materials and the least satisfied with physical learning environment. Students felt comfortable with time organization, with multiple-sources of information, and materials which were up-to-date. IBL enabled all type of interactions (e.g., peer-peer, teacher-student, student-content) using real-classroom and off / online means.

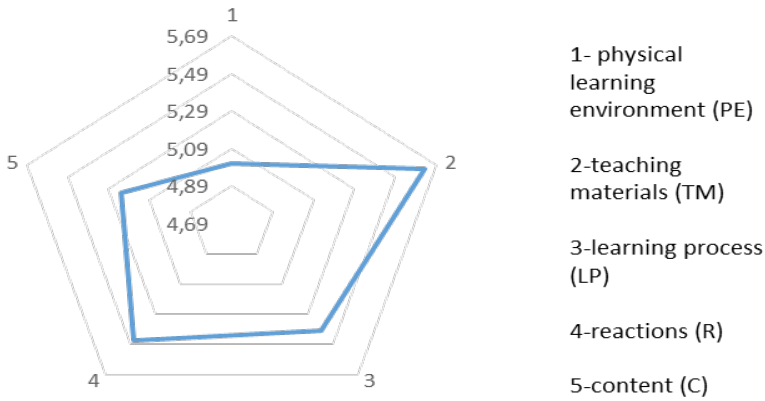

Figure 5. Students' attitudes toward green IBL

Overall student satisfaction with IBL is judged to be moderate. Only learning physical environment needs some modification in terms of workshop equipment, more room for effective work, and some refreshments are necessarily.

IBL and gender differences

Levene's test showed the homogeneity of variance (F (1.258) = 0.12, p = 0.73> 0.005). Multivariate analysis of variance (MANOVA) across all factors of satisfaction revealed statistically significant differences ($p<0.05$). Male students (M= 5.50, SD=1.17) are more satisfied with IBL than females (M=5.24, SD=1.21). Figure 6 shows gender differences at each category of satisfaction. Males were more satisfied almost at all categories of satisfaction, unless with physical learning environment. Significant differences ($p<0.05$) occurred just at scale of Reactions (Mm=5.70, SDm=1.34; Mf=5.31, SDf=1.42) and at Content scale (Mm=5.60, SDm=1.65; Mf=4.99, SDf=1.74) with small effect size (0.02, 0.03; accordingly).

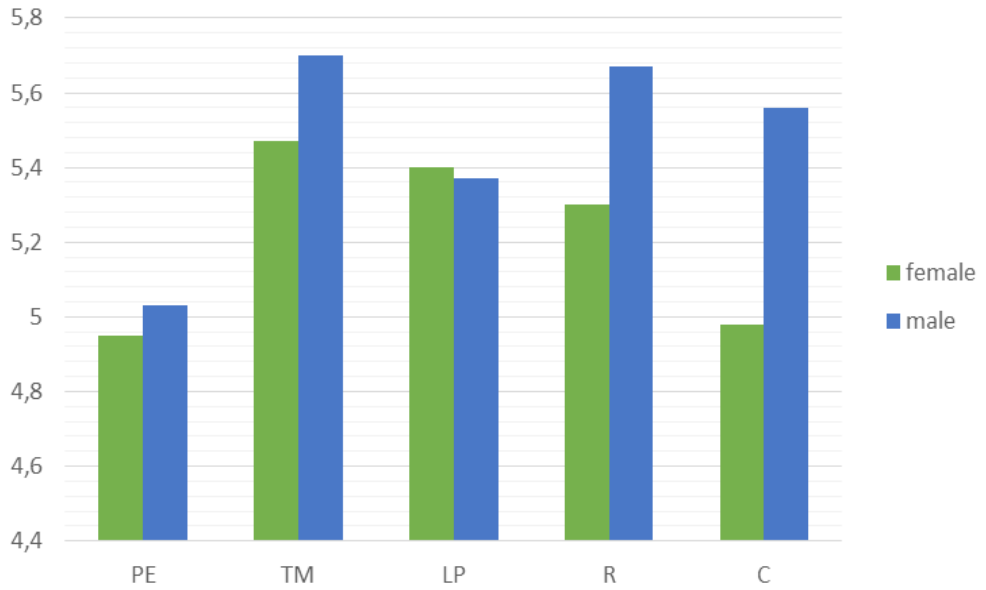

Figure 6. Gender differences according to the categories of satisfaction where is PE-physical learning environment, TM-teaching materials, LP-learning process, R-reactions, and C-content

Female students felt not comfortable with collaborative and cooperative learning in technology-intensive learning environments, and science and technology subject matter seems to be out of primary interest of their study orientation.

Student satisfaction across the IBL topics

Levene's test showed homogeneity of variances at all green topics ($p > 0.05$). MANOVA revealed significant differences ($p<0.05$) in perceived satisfaction with Teaching / learning material, Learning process, and Content considering different area of green competences acquiring. Effect size is regarded as small to moderate ($\eta 2 = 0.34; 0.44; 0.60$; accordingly). Students were the most satisfied with topic of Plants in Space (M=5.55, SD=1.22) and the least satisfied with topic of Green Heating (M=5.05, SD=1.30) (Figure 7).

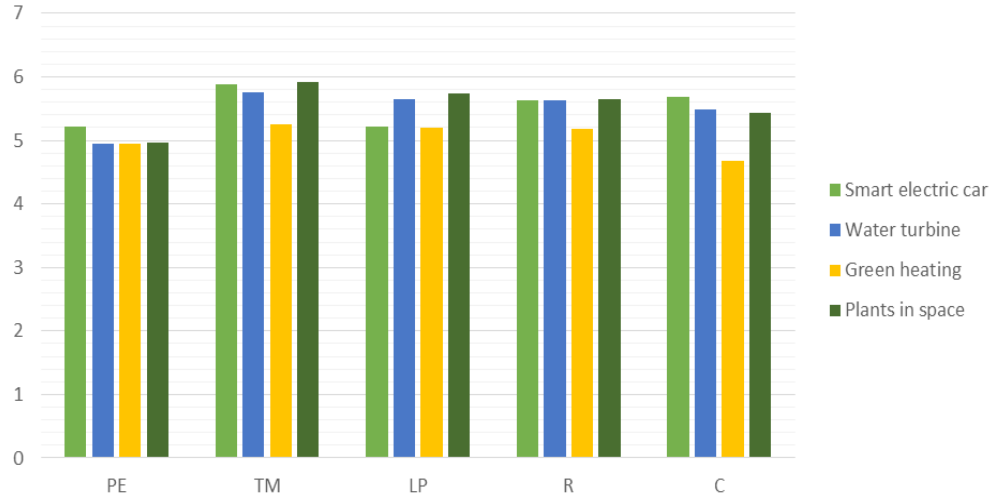

Figure 7. Topics differences according to the categories of satisfaction where is PE-physical learning environment, TM-teaching materials, LP-learning process, R-reactions, and C-content

Students' perceived satisfaction with green heating significantly ($p<0.05$) differs from all other topics at item of Content. This suggests redesign of content topic in a way of inclusion the interesting, clear and organized learning objects and more teacher involvement at IBL to reduce perceived cognitive load, especially at conceptualization phase.

Conclusions

The purpose of the study was how eighth- and ninth-grade students were satisfied with IBL of green topics. It was found that students were moderately satisfied with IBL and technology days. Males were more satisfied than females. It seems that topics more suit to male students. Furthermore, it is important to highlight that such way of work (method IBL) in classroom students are not yet practised. There were too much autonomy for students and less assistance by teachers. Students met this teaching method for the first time, and IBL was shock for them and caused a lot of misconceptions. A minimal guidance or no guidance during IBL was not effective. Doing right explanations and conceptualisation afterwards sometimes increased learning difficulty and this was noticed in perceived high scores of cognitive load of students.

In general, course quality is judge to be moderate to high. Some modifications are need in terms of group design and of motivation material and process for female students. A topic of green heating needs some changes as didactic modification to make learning easy and more effective, by up-to-date and multiple-source material where scaffold learning with timely feedbacks is enabled to reduce cognitive load of students.

Considering green competences, all IBL topics show potential for introduction to compulsory curriculum and learning system. Acquiring of green knowledge and skills using IBL is judged to be suitable and effective method as well for non-formal education and training. Thus, we suggest introduction of the method also to any other green subject matter considering technology and engineering. IBL should advances also at wider competences acquiring, where a lot of interactions at scaffolds during IBL in technology-intensive learning environment develops students communication ability, self-efficacy, self-regulation and turn students attitudes positive toward science and technology. Also, during IBL students develop competences of guidance, management, research work, supervision, and creativity which are essential at innovation process. Perhaps, introduction of IBL in primary and secondary education may changes interest for study of science and technology / engineering, especial of that occupations related to green job sectors.

In paper we investigated student attitude toward teaching / learning green competencies and green topics in open settings. This content is rather seldom involved in formal primary and secondary education, but is a very important content. Many people are not aware of green jobs and green economy, but this is very important especially for our health, environment, safety and national wealth fare. Green sectors and related green jobs are the same or even more economically effective than conventional one, and contributes to preservation of natural resources and environment.

Acknowledgements

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THE CONNECTION BETWEEN TECHNOLOGICAL AND ENVIRONMENTAL LITERACY

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Abstract

Technological literacy is widely accepted as the main goal of technological education at all levels of school. A similar situation is in the field of environmental literacy. Both of these literacies are usually defined as a combination of factors from various dimensions: cognitive (knowledge), behavioural, affective (attitudes, emotions) etc. Just a little is known about the connection between environmental and technological literacy. This paper tries to find these "contact areas" by review of the literature aimed at definitions of environmental and technological literacy as well as recent research in this area. This analysis is partly limited by lack of empirical research work in the field of technological literacy. It must be remembered that both literacies and their development are key prerequisites of "green" society which exists in accordance with the principles of sustainable development. Despite this fact, some common elements of these literacies were found and are presented in the paper.

Keywords: technological literacy, environmental literacy, green society

Introduction

Modern society which is based on ideas of sustainable development requires from its members crucial equipment qualities that enable fulfilment of its goals. Such qualities can also be described as literacies, i.e. sets of skills and knowledge. Within the themes that can be described as green and that are directed towards the fulfilment of practices and ideas of sustainable development technological and

environmental literacy play a very important role. They represent paths that lead an individual to science, technology and environment. Despite this fact we know very little about their mutual interaction and the way they influence each other.

Technological literacy

Technology as one of the major means used to change the world around us has played a crucial role for all humanity as well as for each individual. Talked about in relation with technology and the processes that it represents is so-called "technical thinking". It is a relatively broad term and it can be divided according to various criteria.

While the concept of technical thinking refers mainly to a certain quality, focus or content of individual thinking, the term technical literacy, or more precisely basic technical literacy, refers to a certain threshold, minimum or border line that must be overstepped for living in the present, technologically developed society. It is necessary to discuss the appropriate level, content focus, competences (generally emphasized is the ability to solve technical problems) as well as relations to other fields of education. Such discussion should be based on research as well as practice. The content of both these terms is only fulfilled when the knowledge, skills and habits are interconnected and it depends on the subject's motivation and creativity developing. Nowadays, the importance of critical thinking is strongly emphasized without which technical thinking is unthinkable and technical literacy is unattainable [1].

The roots of the effort to define technical literacy can be found in John Dewey's [2] work. Although this founder of pragmatic pedagogy did not use the term technical literacy, he expressed the importance of technically literal individuals and also the need of collective creation of technical thoughts so that educated citizens capable of critical thinking could be raised.

The International Technology Education Association (ITEA) [3] considers a technological literacy to be an ability to use, manage, evaluate, and understand technology. A technically literate person understands what technology is, how it is created and how society is created in its influence and in opposite how the technology is influenced by society. Such a person is capable of all this despite the fact that the technology is constantly developing. A technically literate person is able to evaluate

the information about technology presented in media, perceive it in context and create his or her own opinion based on this context. He or she can effectively use technology to his or her advantage without a fear of it or in opposition uncritical love for it.

Technological literacy is usually divided into three main components - knowledge, critical thinking and decision making and capabilities [4]. Characteristics of a technologically literate person in these components can be found bellow. The visual presentation of these components and their relationship is in Figure 1.

Characteristics of a technologically literate person [4]:

Knowledge

- Recognizes the pervasiveness of technology in everyday life.
- Understands basic engineering concepts and terms, such as systems, constraints, and trade-offs.
- Is familiar with the nature and limitations of the engineering design process.
- Knows some of the ways technology has shaped human history and how people have shaped technology.
- Knows that all technologies entail risk, only some of which can be anticipated.
- Appreciates that the development and use of technology involve trade-offs and a balance of costs and benefits.
- Understands that technology reflects the values and culture of society.

Critical Thinking and Decision Making

- Asks pertinent questions, of self and others, regarding the benefits and risks of technologies.
- Weighs available information about the benefits, risks, costs, and trade-offs of technology in a systematic way.
- Participates, when appropriate, in decisions about the development and uses of technology.

Capabilities

- Has a range of hands-on skills, such as operating a variety of home and office appliances and using a computer for word processing and surfing the Internet.
- Can identify and fix simple mechanical or technological problems at home or at work.
- Can apply basic mathematical concepts related to probability, scale, and estimation to make informed judgements about technological risks and benefits.
- Can use a design-thinking process to solve a problem encountered in daily life.
- Can obtain information about technological issues of concern from a variety of sources.

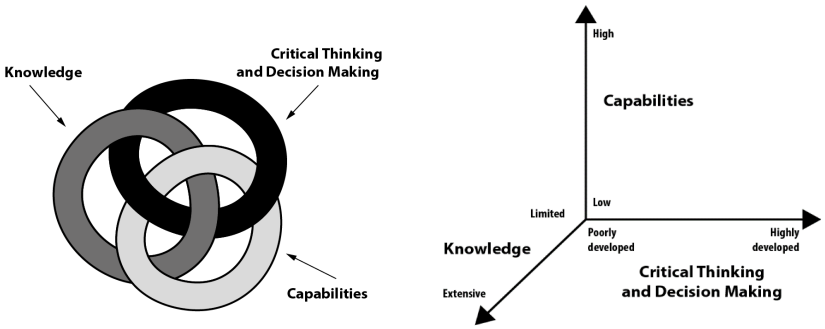

Figure 1. Visual representations of the components of technological literacy

The term technical literacy is seen in the Czech Republic as a technological education minimum that every individual should acquire. The main credit for developing this concept globally is given to Dyrenfurth [5]. In accordance with his beliefs, the requirements of technical literacy can be defined as competencies in the following areas, of course, to the extent of aims given by the individual educational institution:

- Realize the key processes in technology (what it is and how it works),
- Operate technical devices and equipment,

- Apply technical knowledge to new situations,
- Develop their own technical knowledge, skills and habits,
- Use technical information and evaluate it.

According to Bajtoš and Pavelka's [6] publication, the concept of technological literacy includes:

- Acquisition of knowledge about technology, technical materials and acquiring technological skill at a reasonable level,
- Capability to solve technical problems,
- Creating a rational relationship to technology,
- Understanding of the relationship between science and technology and ability to apply such understanding,
- Developing technical creative thinking.

The term technological literacy includes, similarly to the concept of technical thinking, the knowledge, skill and attitudinal component [5].

There is one more important aspect of technological literacy. It is its' cultural universality [7, 8]. Technology is, like e. g. language, pervasive and therefore less perceived. Everybody practices daily a large amount of technological decisions, from lacing to driving. Most of these activities are perceived only marginally and it brings the question if it is possible to identify everyday presence of technological literacy.

Environmental literacy

The concept of environmental literacy (EL) first appeared in 1968 in an article written by Roth [9]. To the awareness of the wider society it got later among others in relation with the definition of environmental education where, however, the phrase "environmental literacy" is missing [10]. The environmentally literate citizen is since then understood as a fundamental objective of environmental education. Nevertheless, the notion of environmental literacy is used in many meanings and its use loses sense as each person imagines it as a set of different qualities [11].

More significant attention was aimed at environmental literacy at the beginning of the 1990s in connection with a "resurgence" of environmental education in the United States of America. The fundamental text of that time is Roth's [11] monograph that tries to define environmental literacy on the base of broader expert consensus and outline the possibilities of its measurement as a way to evaluation in environmental education. Environmental literacy has three levels - nominal, functional and operational. Each of these levels has a series of characteristics that can be divided into four basic strands - knowledge strand, affective strand, skill strand and behaviour strand [11]. This definition has confirmed the broad scope and complexity of environmental literacy and became the basis of a whole series of researches that focused on its individual components.

A significant portion of these researches were used in the search for new, research-based definition of environmental education. In 2011 it was introduced by the North American Association for Environmental Education [12]. This definition of environmental literacy respects the already accepted division into several dimensions but each of them is expressed by a list of its crucial components which are measurable and can be used for evaluation of environmental activities (see Figure 2). It is not, however, realistic to capture all these aspects during measurement of an individual's environment literacy. Ideally an appropriate combination of the aspects should be chosen so that the concept is incorporated from multiple angles. The individual elements are interconnected but the degree of their mutual interaction is not always perfectly clear.

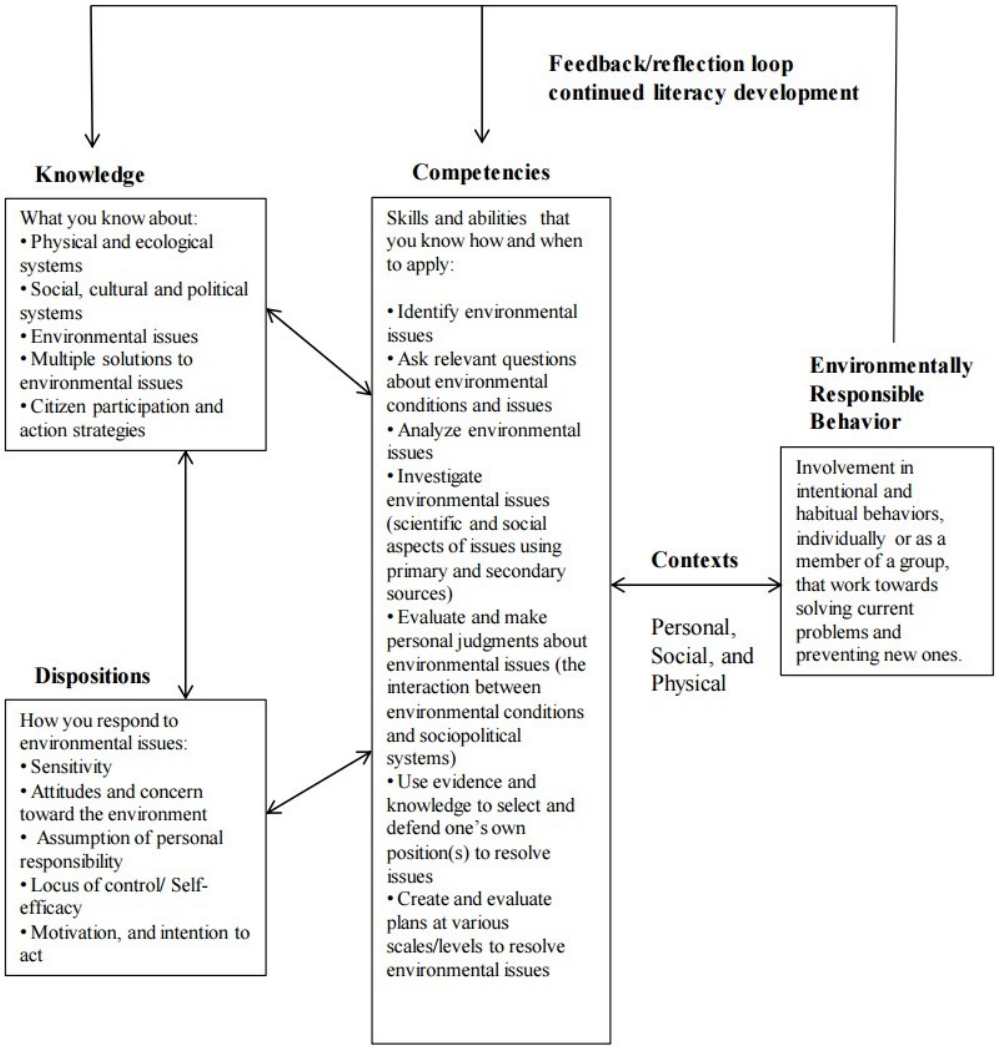

Figure 2. Domain of environmental literacy [13]

McBride et al. [13] presented a comprehensive and detailed comparison of environmental literacy, ecological literacy and ecoliteracy terms. During analysis of available frameworks, some differences between these concepts were defined on the basis of different understanding of various authors. Nevertheless, the composition of the environmental literacy of the four basic dimensions is still accepted.

Connection between Technological and Environmental Literacy

It is obvious from the above mentioned definition of both literacies that there are a number of interfaces that they have in common. They also share a characteristic in spirit of its complexity where both environmental as well as technological literacy consist of a series of aspects which together form a complicated, mutually interacting complex.

Idea of "contact zones", i.e. areas in which these literacies encounter within the personality of an individual can be seen in table 1. Its content presents a synthesis of the characteristics outlined in previous chapters.

Table 1. Comparison of individual components of environmental and technological literacy

	Environmental literacy	**Technological literacy**
Cognitive dimension	Knowledge	Knowledge
Affective dimension	Dispositions	
Skill dimension	Competencies	Capabilities; Critical Thinking & Decision making
Behavioural dimension	Environmentally Responsible Behaviour	Capabilities; Critical Thinking & Decision making

The same moments can be observed in equipping an individual with a specific set of skills and competencies that allow one to actively and competently participate in public life and make decisions in accordance with the trend towards green society and green economy and thus respect the ideas of sustainable development. Examples of the mentioned skills follow:

- Asks pertinent questions, of self and others, regarding the benefits and risks of technologies [4].
- Weighs available information about the benefits, risks, costs, and trade-offs of technology in a systematic way [4].
- Can obtain information about technological issues of concern from a variety of sources [4].
- Ask relevant questions about environmental conditions and issues [12].

- Investigate environmental issues (scientific and social aspects of issues using primary and secondary sources) [12].
- Evaluate and make personal judgements about environmental issues (the interaction between environmental conditions and sociopolitical systems) [12].
- Create and evaluate plans at various scales / levels to resolve environmental issues [12].

An individual that is environmentally and technologically literate is able to analyse the issues and problems of contemporary society and make concrete decisions directed to achieving greater effectiveness while respecting environment.

Acquisition of such competencies is conditioned by education in all its stages and also by the affective component of a personality. Both of these variables are a challenge for further research devoted to the relationship between environmental and technological literacy and their mutual interaction. This relationship does not have a simple form and it can not be said that the individuals with positive attitudes to the environment have a negative influence on science and technology [14].

The elements of technological literacy are a natural part of the personality of a good chemical engineer, thus the connection of environmental and technological literacy is closely connected with principles declared in the project "STRENGTH" [15]. Such a relationship leads to a shift from knowledge to competencies, from education to learning. It can be assumed that searching for connections and relations as well as differences in the understanding of both literacies will lead to greater development and stimulation of both current and future works in chemical engineering as well as in other fields of human activity.

Conclusion

The previous text briefly introduced the most famous and generally accepted definitions of technical and environmental literacy and some contact surfaces were attempted to be found. These certainly exist and within this short paper those related with competencies of individuals that led them to erudite discussion and decision making about problems around them, were mainly brought to attention as it is one of the prerequisites for a society based on the ideas of sustainable development.

Acknowledgment

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MICROWAVES AS A HUMIDITY MEASUREMENT DEVICE

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Abstract

New materials and related research is important subarea also in chemical engineering. At the present time the constantly increasing demands for quality and precision in the manufacture and development of new materials are increasingly important for faster and reliable inspection of testing methods. Therefore, it is advisable to pay attention on technological and even in the chemical industry, physical methods using microwaves in the laboratory and industrial technology. Paper is interested in accurately detect moisture inside of plaster moulds, that will be measured by microwaves apparatus. Part of the thesis is also construction and assembly of the stable apparatus, so that it is possible to monitor the effects of microwaves on a plaster sample, then evaluate the moisture content of the sample and compare it with the weight test.

Keywords: new materials, microwaves, humidity, measurement device

Introduction

At the present time the constantly increasing demands for quality and precision in the manufacture and development of new materials are increasingly important for faster and reliable inspection of testing methods. Therefore, it is advisable to pay attention on technological and even in the chemical industry, physical methods using microwaves in the laboratory and industrial technology.

Use of microwaves is not really new, but it is bad to marginalize them, despite the fact that these technologies create still huge potential for use in the technical industry.

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Establishment of measurable quantities on the microwave apparatus

To the introduction of basic measurable quantities is necessary to summarize some initial knowledge about the propagation of electromagnetic waves.

Electromagnetic wave advancing through rectangular waveguide can be considered as a plane wave, where the propagation direction is according with the longitudinal axis of the straight waveguide. The transverse component of the electric field guided electromagnetic wave is perpendicular to these planes.

For the transverse component of the electric field applies:

$$E_y = E_{p\,max}\sin(\omega t - \beta x) + E_{r\,max}\sin(\omega t + \beta x + \varphi) \tag{1.1}$$

From equation (1.1) we know that the resulting value of the transverse component of the electric field Ey guided wave is the sum of the intensity of the advancing waves from sources of waves and the intensity of waves reflected from the sample material.

Ep max and Er max are the peak values of these intensities. Variable β is called the phase constant and is related to wavelength λv guided wave, which is determined by:

$$\beta = \frac{2\pi}{\lambda_v} \tag{1.2}$$

For the maximum and minimum values of Ey applies:

$$E_{y\,max} = E_{p\,max} + E_{r\,max} \tag{1.3}$$

$$E_{y\,min} = E_{p\,max} - E_{r\,max} \tag{1.4}$$

The ratio of these quantities is characterized as a Voltage Standing Wave Ratio, denoted S:

$$S = \frac{E_{y\,max}}{E_{y\,min}} \tag{1.5}$$

Along the lines can be found many places where Ey reaches its maximum or minimum. By analyzing of the relation (1.1) it can be shown that the distance between adjacent minima's Ey is equal to half the wavelength of the electromagnetic wave in a waveguide:

$$E_y = \frac{\lambda_v}{2} \tag{1.6}$$

This situation is different from the propagation in free space. By analysing of the relationship we obtain:

$$\lambda_v = \frac{\lambda_z}{\sqrt{\varepsilon - \left(\frac{\lambda_z}{\lambda_m}\right)^2}} \tag{1.7}$$

Equation (1.7) shows that the wavelength of the wave in the waveguide is a function of three variables:

λ_z ... Wavelength of the same wave in a free space

λ_m ... Wavelength equal to twice the width of the waveguide

ε ... Relative environment dielectric constant

Measurement of Voltage Standing Wave Ratio in materials research

The receiving antenna probes in the waveguide capture the energy detected by a diode. The detected current is can be substitute to equation:

$$S^2 = \frac{i_{s\,max}}{i_{x\,min}} = \frac{E^2_{y\,max}}{E^2_{y\,min}} \tag{2.1}$$

It means putting the values for maximum and minimum current.

Thanks to Voltage Standing Wave Ratio can quite accurately determine the properties of materials.

Materials detected on the microwave apparatus is divided into two basic groups:

The group A includes materials like plastics, resins, composites, etc.

To the group B includes materials as metal - magnetic or non-ferrous metals, etc.

Basic configuration of microwave measuring devices

The indisputable advantages of microwave apparatus are that the parts are very flexible kit; the parts can be combined or distributed for any other needs of individual measurements.

Block diagram of the apparatus is shown in Figure 1:

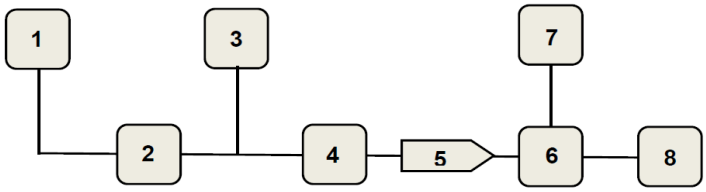

Figure 1. Block diagram of the apparatus

Assembly includes the following parts:

1. Source of operating voltage for the reflex klystron
2. Reflex klystron - the source of electromagnetic waves
3. Wave meter
4. The variable attenuator
5. Straight lines connection
6. Measuring element
7. Indicating meter of detected current
8. Terminating line

Element 8 - terminating line is actually measured material. That means measured element of waveguide.

Humidity measurement of plaster samples

To determine the moisture content of the samples was used plaster weight test, which Determine the amount of moisture saturated and dried samples.

For increased data accuracy of microwave measurement we use three of the known methods for measuring humidity using microwaves. All three methods utilize microwaves interact with the substance (see Figure 1). This is a method of measuring wavelengths in the samples and methods of measurement of attenuation and reflection.

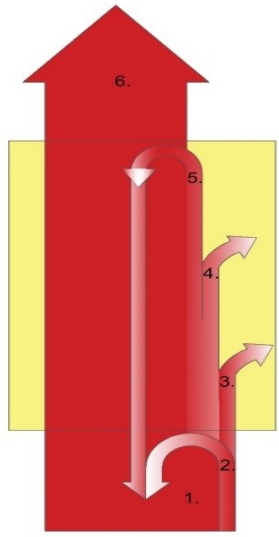

Figure 2. Schematic representation of the interaction of matter and microwaves

Method for measuring of the attenuation and reflection

This method utilizes of the interaction of microwaves with the substance. Method consists of measuring of the attenuation and reflection of electromagnetic waves. When the electromagnetic energy waves passes through the sample, electromagnetic waves interact on the sample. Part of the energy is reflected, part is absorbed by the sample and the rest of the energy passing through the sample on to the microwave line.

The procedure for measuring of the attenuation

We set attenuator at a certain value and on an amplifier we subtracted deflection. After that was subtracted decrease of the deviation with inserted sample. Thus, it is possible to calculate the attenuation in the sample

$$\Delta z = z_1 - z_2 \tag{3.1}$$

z_1 - Decline value measured in air.

z_2 - Decline value measured in the sample.

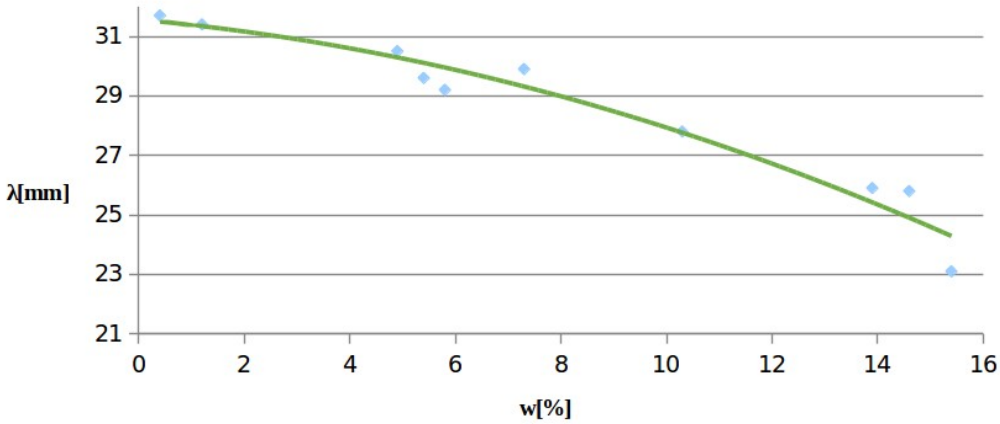

Figure 3. Dependencies size wavelength on the moisture content

Reflection measuring

Measuring Devices for reflection is the same as in the previous case, except for minor modifications. Diodes holder was inserted into the end of measuring waveguide. That is used to absorb the energy flow pattern.

First minimum is measured by line measure probe. After that we have find and measure the maximum. This is deflection value of the standing wave, which can be read on the scale. The values set the *standing wave ratio* (SWR).

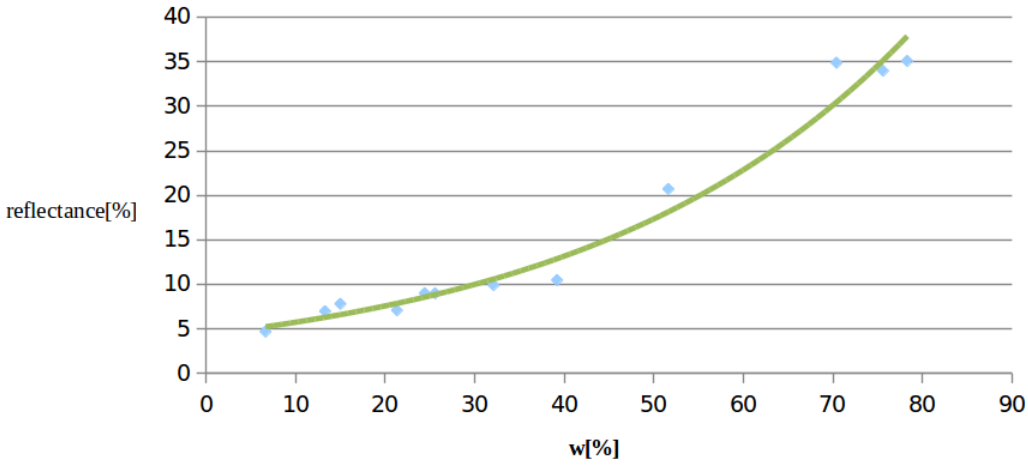

Figure 4. Reflectance values relative to the moisture

The measurement results indicate that the reflection is very good method for moisture measuring. It can be assumed that the moisture of gypsum moulds can be directly inferred merely from the size of the reflection factor.

Conclusions

At the present time the constantly increasing demands for quality and precision in the manufacture and development of new materials are increasingly important for faster and reliable inspection of testing methods. Therefore, it is advisable to pay attention on technological and even in the chemical industry, physical methods using microwaves in the laboratory and industrial technology.

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ECO TRANSFORMATION OF EDUCATIONAL ORGANISATIONS - A CASE OF FACULTY OF EDUCATION AT UNIVERSITY OF LJUBLJANA / OKOLJSKI PROJEKTI V IZOBRAŽEVALNIH USTANOVAH – PRIMER PEDAGOŠKE FAKULTETE V LJUBLJANI

Kostanjevec Stojan, University of Ljubljana, Faculty of Education

Abstract

The Faculty of Education in Ljubljana is the first Slovene faculty participating in the Eco-schools international programme, the goal of which is to encourage awareness of sustainable development among students and employees. The faculty established a programme board, who examined the environmental conditions of the faculty. Based on this examination, they designed a work programme that includes activities referring to sustainable attitude towards the use of energy and water, waste management, transport, the health and the well-being of students and employees. Their special attention was focused on ensuring biodiversity. Within the programme, the faculty introduced a system of separate waste collection, which resulted in decreased waste quantity and expenses for the municipal cleansing service. The users of the faculty building are encouraged, with various slogans, to reduce the use of electricity, water and paper. Various campaigns of collecting reusable materials (clothes, toys, plastic bottle caps) have been organised. Biodiversity has been ensured by planting new plants around the Faculty and by eradicating invasive plants. The employees can borrow bicycles for short distance travels. Consumption of Slovene and locally grown food is promoted through our participation in the Dan slovenske hrane (The day of Slovene food) and Tradicionalni slovenski zajtrk (Traditional Slovene breakfast) projects. In terms of the mission of the Faculty of Education, the environmental contents are part of some subjects in various study programmes and inter-subject connections are encouraged as well. In 2014, the Faculty received an international award – a green flag that represents institutions actively supporting the environment and fulfilling FEE (the Foundation for Environmental Education) international criteria.

Keywords: environmental education, eco-school, Faculty of Education

Povzetek

Pedagoška fakulteta v Ljubljani je prva slovenska fakulteta, ki se je vključila v mednarodni program Ekošola (Eko-schools), katerega cilj je spodbujati ozaveščenost študentov in zaposlenih o trajnostnem razvoju. Na fakulteti je bil ustanovljen programski odbor, ki je opravil pregled okoljskega stanja na fakulteti. Na osnovi pregleda je bil oblikovan program dela, ki vključuje dejavnosti, ki so povezane s trajnostnim odnosom do porabe energije in vode, ravnanja z odpadki, s transportom, z zdravjem ter dobrim počutjem študentov in zaposlenih. Posebna pozornost je namenjena tudi zagotavljanju biotske raznovrstnost. V okviru programa je fakulteta uvedla sistem ločenega zbiranja odpadkov, ki je vplival na zmanjševanje količine odpadkov in stroškov za njihov odvoz. Uporabnike stavbe z različnimi napisi spodbujamo k zmanjševanju porabe elektrike, vode in papirja. Organizirane so različne akcije zbiranja materialov, ki se lahko ponovno uporabijo (oblačila, igrače, plastični zamaški). Biotsko raznovrstnost zagotavljamo s sajenjem novih rastlin v okolici fakultete in z zatiranjem invazivnih vrst. Zaposleni si lahko za krajše prevoze sposodijo kolesa. Uživanje slovenske in lokalno pridelane hrane spodbujamo z vključevanjem v projekta Dan slovenske hrane in Tradicionalni slovenski zajtrk. Glede na poslanstvo Pedagoške fakultete se okoljske vsebine obravnavajo pri nekaterih predmetih različnih študijskih programov, pri čemer spodbujamo medpredmetno povezovanje. Leta 2014 je fakulteta za opravljeno delo prejela mednarodno priznanje – zeleno zastavo, ki predstavlja ustanove, ki delujejo okoljevarstveno in izpolnjujejo mednarodna merila FEE (Foundation for Environmental Education).

Ključne besede: okoljsko izobraževanje, ekošola, Pedagoška fakulteta

Uvod

Razvoj sodobne družbe je usmerjen v spoštovanje in doseganje temeljnih ciljev trajnostnega razvoja, ti pa so usmerjeni v telesno, duševno, socialno, kulturno in v gospodarsko blaginjo prebivalstva. Brundlandova komisija je leta 1987 trajnostni razvoj definirala kot "razvoj, ki zadovoljuje potrebe zdajšnjih generacij, ne da bi ogrozil možnosti prihodnjih generacij, da bodo tudi te lahko zadovoljevale svoje potrebe" [7]. Vzgoja in izobraževanje za trajnostni razvoj se začneta že v vrtcu in osnovni šoli. Pomen vzgoje in izobraževanja v predšolskem in šolskem obdobju je predstavljen v Smernicah vzgoje in izobraževanja za trajnostni razvoj od predšolske vzgoje do

univerzitetnega izobraževanja, ki jih je sprejelo Ministrstvo za šolstvo in šport. V omenjenem dokumentu se poudarja pomen formalnega, neformalnega in priložnostnega učenja za trajnostni razvoj, ki ima osrednje mesto v razvoju vzgoje in izobraževanja v Republiki Sloveniji. Posebej so poudrajeni spoštovanje človeških vrednot, dejavno državljanstvo, medkulturni dialog, ohranjanje narave in varovanje okolja, kakovostno izobraževanje in medosebni odnosi, razvoj socialnih kompetenc, zdrav življenjski slog, krepitev zdrave samozavesti in samopodobe, kakovostno preživljanje prostega časa, razvijanje podjetnosti kot prispevka k razvoju družbe in okolja ter spoznavanje različnih področij kulture in spodbujanje ustvarjalnosti pa tudi dejavnosti [5]. Za kakovostno izvajanje vzgoje in izobraževanja za trajnostni razvoj je pomembno, da izobraževalne ustanove zagotovijo ustrezno okolje in usposobljene učitelje, ki s svojim strokovnim znanjem in z zgledom vplivajo na oblikovanje pozitivnega vedenja ter navad otrok in mladostnikov.

Godec [3] poudarja, da je treba vsebine trajnostnega razvoja vključiti na vse ravni izobraževanja. Zsóka, MarjainéSzerényi, Széchy in Kocsis [6] ter Azmahani s sod. [1] ocenjujejo, da bodo imeli današnji študentje v prihodnosti velik vpliv na ohranjanje okolja, zato je treba vsebine trajnostnega razvoja vključevati tudi na terciarno raven izobraževanja. Z izobraževanjem študentov za trajnostni razvoj bodo študentje pridobili ustrezna znanja in veščine ter razvili pozitivne vrednote o trajnostnem razvoju. Marentič Požarnik [4] navaja, da lahko študentje učinkoviteje razvijajo veščine in vrednote o trajnostnem razvoju, če pri študijskem procesu uporabimo izkustveno, spoznavno in akcijsko zasnovane metode. Aktivne in kooperativne oblike dela so priporočene tudi v Smernicah vzgoje in izobraževanja za trajnostni razvoj od predšolske vzgoje do univerzitetnega izobraževanja. Spodbuja in usmerja se k sistematičnemu, h kritičnemu in k ustvarjalnemu mišljenju na vseh stopnjah izobraževanja, obravnavi trajnostnih tem prek celostnega pristopa, kar lahko dosežemo z aktivnimi in s kooperativnimi oblikami dela ter z medpredmetnim povezovanjem [5]. Erjavšek, Kostanjevec in Lovšin Kozina [2] ugotavljajo, da Pedagoška fakulteta v Ljubljani študentom ponuja pester izbor vsebin trajnostnega razvoja, ki so vključene v različne študijske programe in različne projekte. Z vključevanjem Pedagoške fakultete v program Ekošola se izkazuje zanimanje fakultete, da razvija in spodbuja aktivnosti, ki študentom omogočajo, da usvojijo znanja in oblikujejo pozitivna stališča ter vrednote do trajnostnega razvoja, kar lahko vpliva tudi na učinkovito izvajanje vzgojno-izobraževalnih dejavnosti na različnih stopnjah izobraževanja, na katerih se bodo zaposlovali diplomanti Pedagoške fakultete. V

prispevku je predstavljen proces vključevanja Pedagoške fakultete v program Ekošola, predstavljene pa so tudi aktivnosti, ki so bile izvedene v okviru programa.

Vključevanje Pedagoške fakultete v program Ekošola

Mednarodni program Ekošola (www.ekosola.si) je program, ki je namenjen okoljskemu izobraževanju in vzgoji, ustanove, ki so vključene v program, pa otroke in mladostnike usmerjajo k spodbujanju ozaveščenosti o pomenu trajnostnega razvoja za življenje danes in v prihodnosti. Vrtci in šole z zeleno zastavo izkazujejo izpolnjevanje pogojev za vključenost v program. V letu 2013 se je Pedagoška fakulteta odločila, da pristopi k programu Ekošola. V pristopni fazi programa je fakulteta začela izvajanje sedmih temeljnih korakov programa, ki so predstavljeni v nadaljevanju.

Prvi korak: Vzpostavitev ekoodbora

Ustanovljen je bil ekoodbor, ki ga sestavljajo predavatelji, asistenti, študenti in tehnično osebje. Odbor je zadolžen, da pripravi načrt dejavnosti, ki se izvajajo v študijskem letu, ter da poskrbi za izvedbo in evalvacijo načrtovanih dejavnosti.

Drugi korak: Ocena okoljskega stanja na fakulteti oz. okoljski pregled

Program Ekošola predvideva, da se ugotovi okoljsko stanje na fakulteti. Področja, ki so vključena v pregled, so: energija, odpadki, voda, transport, zdravje in dobro počutje, okolica šole, biotska raznovrstnost. Pregled okoljskega stanja je bil izveden v študijskem letu 2013/14.

Tretji korak: Ekoakcijski načrt

Ekoakcijski načrt se oblikuje na začetku študijskega leta. Vključuje predvidene dejavnosti, ki vsebujejo obvezna področja: voda, energija in odpadki. Ekoakcijski načrt se vpiše v spletno aplikacijo.

Četrti korak: Nadzor in ocenjevanje

Četrti korak predvideva spremljanje in nadzor nad izvajanjem predvidenih dejavnosti. Nadzor lahko izvaja tudi regijski koordinator programa Ekošola.

Peti korak: Okoljske vsebine v študijskem programu

Predavatelji so spodbujeni, da obravnavajo okoljske vsebine pri predmetih, pri katerih je to mogoče. Spodbuja se tudi medpredmetno povezovanje.

Šesti korak: Obveščanje, ozaveščanje in vključevanje

Študente, zaposlene in druge uporabnike stavbe Pedagoške fakultete se obvešča o izvajanih aktivnostih. Spodbuja se jih k trajnostnemu vedenju.

Sedmi korak: Ekolistina

Fakulteta pridobi zeleno zastavo in podpiše ekolistino. Pedagoška fakulteta je pridobila zeleno zastavo septembra 2014.

Program se je na fakulteti začel izvajati v študijskem letu 2013/14, ko so bili imenovani člani ekoodbora in je bil oblikovan načrt dejavnosti, ki so se izvajale v omenjenem študijskem letu. V nadaljevanju so predstavljene dejavnosti, ki so bile na fakulteti izvedene v študijskih letih 2013/14 in 2014/15.

Izvedba dejavnosti v programu Ekošola

V okviru programa je bil na začetku oblikovan logo programa (slika 1). Glede na namen programa so bili na fakulteti prepoznani in analizirani okoljski problemi, ki se pojavljajo v notranjem in zunanjem okolju fakultete. Dejavnosti smo usmerili zlasti na področja ravnanja z odpadki ter trajnostne oskrbe z vodo in energijo. Poleg omenjenih dejavnosti pa so bile aktivnosti usmerjene tudi v različne zbiralne akcije ter ozaveščanje študentov in zaposlenih o okoljski problematiki.

Slika 1. Logo programa EKO PeF

Ravnanje z odpadki

Pred pristopom Pedagoške fakultete v program Ekošola se na fakulteti ni namenjalo posebne pozornosti načrtnemu in natančnemu ločenemu zbiranju odpadkov. Z analizo stanja in pregleda stroškov za odvoz odpadkov je bilo ugotovljeno, da je treba oblikovati program ločevanja odpadkov in zagotoviti ustrezno število zabojnikov za ločeno zbiranje odpadkov. Fakulteta je v okviru izvedbenega načrta zagotovila ustrezno število zabojnikov. V predavalnice in druge prostore so bili nameščeni koši za

ločeno zbiranje bioloških odpadkov, papirja, embalaže in mešanih odpadkov (slika 2). V bližini biološkega praktikuma je bil nameščen tudi kompostnik (slika 3).

Slika 2. Koši za ločeno zbiranje odpadkov

Slika 3. Kompostnik

Ločevanje odpadkov se je med študenti in zaposlenimi spodbujalo z ozaveščevalnimi akcijami in napisi, ki so bili nameščeni na posameznih koših ter na plakatih na različnih mestih stavbe. Posebna pozornost je bila namenjena ločenemu zbiranju papirnatih higienskih brisačk, ki se zbirajo v koših in zabojnikih za biološke odpadke. Ločeno zbiranje odpadkov je vplivalo tudi na zmanjševanje stroškov za odvoz odpadkov. Študenti so izvedli tudi očiščevalno akcijo v okolici fakultete.

Energija

Na fakulteti se je začelo mesečno spremljanje porabe električne energije. Ugotovljeno je bilo, da je treba v prihodnje razmišljati o zamenjavi starih svetil in jih nadomestiti z varčnejšimi. Študenti so v okviru seminarskih del izvedli analizo učinkovitosti in smotrnosti osvetlitve prostorov v stavbi fakultete. Posebna pozornost se je namenila ugašanju luči v toaletnih prostorih. Uporabnike omenjenih prostorov se

z napisi spodbuja k ugašanju luči. Zaposlene se spodbuja tudi k smotrni uporabi elektronskih naprav.

Slika 4. Napisi ob stikalih za luči

Voda

V ustanovi smo začeli mesečno spremljanje porabe vode. Študente se spodbuja k pitju vode, pri čemer se jim ponuja možnost, da pijejo vodo iz javnega vodovoda. Spodbuja se jih k uporabi steklenic in plastenk za večkratno uporabo. Na nekaterih pipah se meri poraba vode z elektronskimi merilci, kar spodbuja uporabnike, da so pozorni na količino porabljene vode.

Slika 5. Elektronski merilec porabe vode

Okolica fakultete

V okolici fakultete je več zelenih površin. Ob povečanju parkirnega prostora se je fakulteta odločila, da nov del parkirišča ozeleni s travnato površino, kar je bila

smotrna in do okolja prijazna rešitev. V okolici fakultete je bil zasajen oreh, poskrbljeno pa je bilo tudi za zatiranje japonskega dresnika kot invazivne tujerodne rastlinske vrste. Za določanje lesnatih rastlin, ki rastejo v okolici fakultete, je na voljo tudi Digitalni biološki ključ za določanje lesnatih rastlin v okolici Pedagoške fakultete, ki je dostopen na spletni strani: http://www2.pef.uni-lj.si/kemija/kljuc/dolocevalni_kljuc.pdf. V študijskem letu 2014/15 so bile na drevesa ob fakulteti nameščene ptičje valilnice, ki so jih izdelali študenti.

Slika 6. Ptičja valilnica

Slika 7. Zatiranje japonskega dresnika

Transport

Z uvedbo izposoje koles se zaposlene spodbuja k uporabi do okolja prijaznih transportnih sredstev. Kolesa omogočajo zaposlenim, da se izogibajo uporabi osebnih avtomobilov za mestno vožnjo.

Slika 8. Izposoja koles

Zbiralne akcije

Pomemben prispevek k trajnostnemu razvoju predstavlja tudi ponovna uporaba že uporabljenih materialov. V različnih zbiralnih akcijah je sodelovalo večje število študentov. Organizirana je bila akcija zbiranja igrač, oblačil, plastičnih pokrovčkov in mobilnih telefonov, iz katerih je umetnik v središču Ljubljane izdeloval mozaik. Zbrana oblačila in igrače so bili podarjeni društvom in dobrodelnim organizacijam.

Slika 9. Zbiranje mobilnih telefonov

Ozaveščevalne dejavnosti

Dejavnosti, ki potekajo v sklopu programa Ekošola, morajo biti na ustrezen način promovirane, da dosežejo širok krog ljudi, ki so jim namenjene. Za obveščanje je bila v avli fakultete postavljena okoljska informacijska točka, na kateri so bile objavljene različne novice s področja trajnostnega razvoja in obvestila o dogodkih, ki so potekali v okviru programa Ekošola. Obveščanje deležnikov pa je potekalo tudi prek fakultetne spletne strani.

Maja 2015 je na Pedagoški fakulteti potekal okoljski teden. V tem tednu so se razvrstile številne dejavnosti, katerih vsebina se je nanašala na okoljske teme. 6. junija, ob svetovnem dnevu okolja, pa je bila pripravljena razstava, na kateri so bile predstavljene dejavnosti programa Ekošola. Razstavo so vsebinsko dopolnjevale tudi predstavitve dejavnosti, ki so jih študenti izvajali v študijskem letu.

Slika 10. Razstava ob svetovnem dnevu okolja

Fakulteta se je 3. petek v novembru pridružila akciji z naslovom Dan slovenske hrane. V okviru omenjenega dneva so študentje v sodelovanju s podjetjem Slorest pripravili slovenski zajtrk ter ga ponudili študentom in zaposlenim. Namen dejavnosti je bil spodbujati uživanje lokalno pridelane hrane in zajtrka.

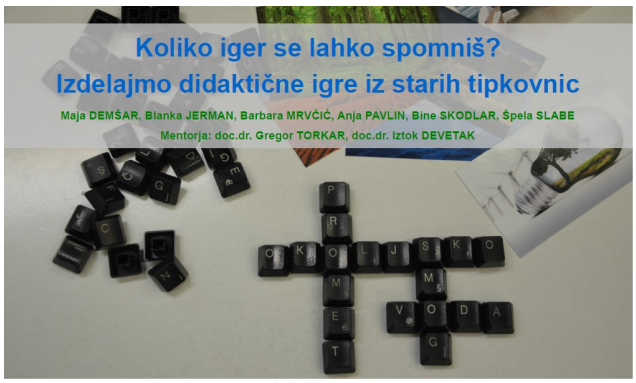
Slika 11. Dan slovenske hrane in slovenski zajtrk

Medkulturno povezovanje in spoznavanje načina prehranjevanja različnih evropskih narodov je bilo omogočeno na razstavi jedi, ki so jih pripravili študenti na izmenjavi Erasmus.

Slika 12. Razstava jedi evropskih narodov

Pedagoška dejavnost in sodelovanje v projektih

Vsebine trajnostnega razvoja se pojavljajo v različnih študijskih programih, ki se izvajajo na Pedagoški fakulteti v Ljubljani [2]. V okviru programa Ekošola se nosilce predmetov spodbuja, da se medpredmetno povezujejo ter da svoje aktivnosti predstavljajo sodelavcem in študentom. Študenti pri različnih predmetih izdelujejo didaktična gradiva, ki so povezana z okoljsko vsebino (slika 6 in slika 13).



Slika 13. Didaktična igra

Pedagoška fakulteta je bila vključena v projekt STRENGTH: Structuring of work related competences in chemical engineering. Ta je potekal v okviru programa LLP Leonardo da Vinci – Transfer of Innovation. Več informacij je dostopnih na spletni strani http://www.greenstrength.eu/index.php/en.

Naravi naproti: razvoj interaktivnih didaktičnih gradiv za spodbujanje trajnosti pa je bil naslov projekta Javnega sklada RS za razvoju kadrov in štipendije. Cilj projekta je bil omogočiti študentom, prihodnjim pedagoškim delavcem, konkretno izkušnjo v realnem delovnem okolju, z razvojem interaktivnih didaktičnih gradiv, ki so namenjena izobraževanju učencev na področju trajnostnega razvoja. Več informacij je dostopnih na spletni strani https://www.pef.uni-lj.si/pkp-naravi-naproti.html.

Zaključek

Pedagoška fakulteta je prva ekofakulteta v Sloveniji in ima pomembno vlogo pri izobraževanju prihodnjih učiteljev, ki jih lahko tudi usposablja za poučevanje okoljskih in trajnostnih vsebin. Ocenjujemo, da so bile v preteklih letih v okviru programa Ekošola izvedene številne dejavnosti, ki spodbujajo in usmerjajo Pedagoško fakulteto k trajnostnemu razvoju. Dejavnosti izvajajo študenti in zaposleni, kar lahko pomembno prispeva k oblikovanju pozitivnih namer, stališč in oblik vedenja zlasti študentov, ki bodo v svoji poklicni praksi lahko spodbujali otroke in mladostnike k izpolnjevanju ciljev okoljske vzgoje in trajnostnega razvoja. Za uspešno delovanje programa je pomembno medsebojno sodelovanje zaposlenih in študentov, ki skupaj oblikujejo cilje programa in prevzemajo odgovornost za opravljanje načrtovanih nalog.

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