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ADVANCEMENT OF MASTER'S PROFESSIONAL DEVELOPMENT PROGRAM ESTABLISHED FOR ENVIRONMENTAL ENGINEERS

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УДОСКОНАЛЕННЯ ПРОГРАМИ ПРОФЕСІЙНОЇ МАГІСТЕРСЬКОЇ ПІДГОТОВКИ ІНЖЕНЕРІВ-ЕКОЛОГІВ

Purpose. Theoretical and methodological substantiation of the key directions for improvement of the master's training programs for environmental engineers in the context of higher education reform in Ukraine, as well as challenges in the sustainable development of its regions.

Methodology. The study based on the fundamental provisions of the learning theory and the concept of higher education, and new policy goals in the fields of higher environmental education in Ukraine, as well as the research of home and foreign scientists, which are devoted to improving the quality of master level education, and generalization of Ukrainian experience in the creation of industry standards for professional education of environmental specialists.

Findings. This study proved the necessity of complex and synergetic approaches to the development of master's training program, according to which it is regarded as a flexible and dynamic set of interrelated subjects and other training activities. In general, it should respond to changing market conditions and State programmes on the environment and sustainable development. The content and structure of the master's programs should be adapted to the changing needs of the labor market and to the objectives of sustainable development of certain industries or regions, taking into account existing scientific base, experience and specific academic profile of the University. The analysis of contemporary views on the mission of higher education institutions and on the strategic objectives of the higher education in Ukraine shows that professional educational program envisaged for masters should be more flexible and effective. It should facilitate the transition of the higher environmental education to a new model that will provide the interconnection, development and improvement of all components of higher education in the context of sustainable development at the level of certain Communities and Regions.

Originality. Unlike the existing approaches, the proposed methodology is based on the principles of multi-disciplinary approach, by increasing the variable part of the curriculum, deepening of profiling and prioritization of research practical training, that provides a comprehensive and dynamic development of master's programs in professional education, in particular for environmental specialties.

Practical value. Implementation of the proposed measures may increase the compliance of the qualification level of the graduates, environmental engineers with the current needs of the labor market in the context of sustainable development of a certain region.

Keywords: *sustainable development, ecological education, master's professional program*

Problem statement. An important step for Ukraine became the development and adoption of the "Concept of Ecological Education in Ukraine", approved by the Board of the Ministry of Education of Ukraine (Protocol No. 13 / 6-19 dated 20/12/2001) [1]. In accordance with this Concept, ecological education as well as science of Ecology itself has been reformed into a multidisciplinary educational and scientific sphere. It is possible to say that modern ecological education shall include not only fundamental basics for environment- and nature-oriented knowledge, but also other applied sciences about environmental protection and management [2-3].

Moreover, sustainable concept of society development forms the need in a new integrated system of education,

where the initiative shall rightfully belong to ecological education [4].

Identification of an unsolved problem. 10 years of implementation of "Concept of Ecological Education of Ukraine" proved the importance of higher ecological professional education, which shall be differentiated, diversified and should cover all the levels of professional training considering the needs of individuals, regions and the state into account [1]. That is why basic provisions of the concept are still being actively discussed among researchers and more public of Ukraine [2-5].

The question of the development of professional training programs for highly qualified ecologists, first, has become even more relevant within the regional and local issues of sustainable development. Accordingly, each higher education establishment shall determine the profile that would meet the staffing needs for sustainable development

of the region's industry, taking its scientific, material and human resources into account.

Analysis of the recent research. More than 10 years SMC on Ecology (Scientific and Methodical Commission on Ecology of the Ministry of Education of Ukraine) develops the unified strategy of higher ecological education in Ukraine, which was gradually improved. Significant contribution to its formation was made by such scientists as Nekos V.E., Stepanenko S.N., Vladimirov E.G., Safranov T.A., Belavskii G.A., Bogoliubov V.M., Klimenko N.A., Malovanyi M.S., Panasenko A.I., Shmandii V.M., Timoshenko N.I. and others.

Now this strategy is implemented through a system of industry standards for professional education for specialty "Ecologists" based on the state educational standard of higher professional education in Ukraine (Higher Education Standard of the Ministry of Education and Science 6.040106-11) [6].

Identification of the unsolved part of the general problem. The possibility of further advancement of the higher ecological education strategy has become more real upon the adoption of the new Law of Ukraine "On Higher Education" (from 01.07.2014 № 1556-VII) [7]. The increase in institutional autonomy of education establishments gives them the right to revise the structure of professional training programs, in particular for ecologists, for better adaptation of these programs to current conditions of the labor market. For example, Master's professional program for environmental engineers under new specialty "Applied Ecology and Balanced Use of Natural Resources (by Industries)" is relevant for Poltava Region.

Formulation of the research aim and objectives. The purpose of this paper is to identify key directions and to develop recommendations for staged advancement of Master's professional program for environmental engineers in the context of the requirements of new Law of Ukraine "On Higher Education".

Presentation of the research results. Poltava National Technical University named after Yuri Kondratyuk (PNTU) was appointed to head working committee on the development of the higher education industry standard with a degree in 8.04010602 "Applied Ecology and Balanced Use of Natural Resources (by Industries)", approved by Ministry of Education of Ukraine order No. 1367 of 3 December 2012 [8].

It is only the second year when the university trains masters of this degree. However, 16-year experience of PNTU in training Bachelors in Ecology and 12-year experience in training Masters in Ecology with a degree in "Ecology and Environmental Protection" plays an essential role. The possibility to effectively advance Master's professional development program has become more real at the result of transition to 1.5, and 2-year training of Masters according to new Law of Ukraine "On Higher Education" [9].

To do this, the authors performed the analysis and defined strengths and weaknesses of Master's professional program within the specialty "Applied Ecology and Balanced Use of Natural Resources (by Industries)".

The structure of educational and professional program (EPP) within the specialty "Applied Ecology and Balanced

Use of Natural Resources (by Industries)" has been optimized for 1-year training term for Masters (60 ECTS credits). Optimization provides the relationship between the normative and variative part of the Overall master's professional development program (theoretical, practical) in the ratio 65:35%. Theoretical training makes about 55% of the total education time or 33 ECTS credits (at the current rate of 1 ECTS = 36 hours).

The strong point of the program under 1-year training term established for Masters is essential time allotted for practical training (15% of the total time) in the form of two types of practices: scientific and industrial and pre-degree practice. The overall goal of the practice is formation and development of students' professional skills for provision of *independent solutions* at a particular production, mastering current methods, forms of organization work, and methods of work within the framework of future profession.

However, in recent years, the proper implementation of practical training in many higher education establishments, especially for Master's level of technical orientation, has faced with serious difficulties. Their bases for practice could be industrial enterprises, research institutes, state environment-oriented authorities, certification centers as well as other organizations.

Moreover, the weaknesses of the program under 1-year training term for Masters are as follows:

- Low interdisciplinary nature of the plan of 1-year training term for Masters, i.e. weak relationship between ecological, technological, economic and legal applied training of ecologists.

- Poor scope of variative part of the curriculum within the framework of which it is difficult to implement effective adaptation of the program to the specifics of a particular region or industry.

- As a consequence, within the time allotted for the cycle of elective disciplines (6.0 ECTS credits) it is difficult to ensure Masters to deep profiling in the selected field.

Students' opportunity to choose a certain field for deep training helps to form more serious knowledge base in the field of their Master's thesis. In addition, psychologically important aspect here is the factor of self-determination, which can help students to form themselves not only as professionals but also as individuals in the future.

Thus, we believe that the development of Master's professional program requires a well-thought-out approach to the formation of the cycle of elective disciplines, where the main reference point shall be a combination of natural disciplines and professional practice. It is the orientation which requires consideration of fields for advancement, restructuration and elimination of weaknesses in the Master's professional development program.

Improvement of the master's program "Applied Ecology and balanced use of natural resources (by industry)" should:

1. To increase the variable part of professional development program to 24.5 ECTS credits (27.2% of the total training time) for 1.5-year training term established of Masters (table 1) and to 42.0 ECTS credits (35% of total training time) for 2-years training term of Masters (table 2).

2. To ensure interdisciplinary nature of education through the introduction of such special courses as:

- “Economics of Environment and Natural Resources”, “Eco-Economic Analysis of Enterprise activity”.
- “Legal Regulation of Ecological Activity”, “Legal Basics of Ecological Policy and EU Law”; for 2-years training. - “Ecological and Legal Security of Enterprises”.

3. To ensure a deep profiling by forming a cycle of elective courses:

- In the form of four blocks for 1.5-year training: economic, eco-legal, eco-technological, information and monitoring, with the total load of 14 ECTS credits.

- In the form of choice to elect one of the two Master’s programs with the total load of 26 ECTS credits

each for 2-years training: “Environmental Security of an Enterprise” or “Management of Ecological Activity”.

4) To change the structure of practical training, which shall be represented by two types of practices: research and pre-degree ones; for 2-years training, an additional third kind of practice, that is scientific and pedagogical, shall be introduced (table 3).

In our opinion, the emphasis shall be made on research part of practice, under which students can perform various types of investigations both directly at industry objects, and at scientific, chemical and analytical laboratories, monitoring centers, state regulatory organizations and other structures.

Table 1

Total Content of Training Masters with 1.5-year Studying Term
(For 8.04010602 “Applied Ecology and Balanced Use of Natural Resources (by Industries)”)

| No. | Component of the Master’s Professional Program | Number of ECTS credits | % from general theoretical training | Number of work weeks |
|-----|--|-----------------------------|-------------------------------------|----------------------|
| 1 | Theoretical training, incl.: - compulsory part - variative part / incl. cycle of elective courses | 51.0 26.5 24.5 / 14.0 | 56.7 % 27.2% / 15.6% | 34 |
| 2 | Practical training, incl.: - scientific and research (variative part) - pre-degree practice (compulsory part) | 9.0 4.5 4.5 | 10 % | 6 3 3 |
| 3 | Work on the Master’s thesis | 30.0 | 33.3 % | 19 |
| | Total | 90.0 | 100 % | 60 |
| | State certification | 1.5 | | 1 |

Table 2

Total Content of Training Masters with 2-year Studying Term
(For 8.04010602 “Applied Ecology and Balanced Use of Natural Resources (by Industries)”)

| No. | Component of the Master’s Professional Program | Number of ECTS credits | % from general theoretical training | Number of work weeks |
|-----|---|-----------------------------|-------------------------------------|----------------------|
| 1 | Theoretical training, incl.: - compulsory part - variative part / incl. cycle of elective courses | 76.5 34.5 42.0 / 26.0 | 63.75 % 35% / 21.7% | 51 |
| 2 | Practical training, incl.: - scientific and pedagogical (compulsory part) - scientific and research (variative part) | 15.0 4.5 10.5 | 12.5 % | 10 |
| 3 | Work on the Master’s thesis | 28.5 | 23.75 % | 19 |
| | Total | 120.0 | 100 % | 80 |
| | State certification | 1.5 | | 1 |

Therefore, we consider it appropriate to refer research practice to the variable part of the program for further opportunities to expand its scope by choosing convenient forms and terms of its implementation by each separate higher education establishment.

In addition, 2-years professional development program should include the scientific and pedagogical practice during 1 semester within the framework of two special courses: “Methodology of Teaching in Higher School” and “Pedagogy and Psychology of Higher School”.

Research conclusions and outlook. Summing up the analysis of the Master’s professional program with a degree in 8.04010602 “Applied Ecology and Balanced Use of Natu-

ral Resources (by Industries)”, the following key directions for its advancement can be identified:

- The provision of multi-disciplined approach for training Masters in Ecology.

- The strengthening variative part of the educational programs, which shall allow higher education establishments to adapt their educational services to the specific needs of a particular region (industry) most effectively.

- The provision of greater choice of elective courses which shall help students to form as professionals in the context of the sustainable development requirements.

- The gradual advancement of practical training with the expansion of its research part.

Table 3

Characteristics of practical training of Masters with a degree in
8.04010602 “Applied Ecology and Balanced Use of Natural Resources (by Industries)”

| No. | Type of Practical Training | Time for Practical Training | |
|-------------------------------------|---|-----------------------------|----------------------|
| | | Number of ECTS credits | Number of work weeks |
| 1-year studying term for Masters | | | |
| 1 | Scientific and production practice | 3.0 | 2 |
| 2 | Pre-degree practice | 6.0 | 4 |
| | Total | 9.0 | 6 |
| | Total for training of Masters | 60.0 | |
| 1,5- year studying term for Masters | | | |
| 3 | Scientific and research practice | 4.5 | 3 |
| 4 | Pre-degree practice | 4.5 | 3 |
| | Total | 9.0 | 6 |
| | Total for training of Masters | 90.0 | |
| 2- year studying term for Masters | | | |
| 2 | Scientific and pedagogical practice | 4.5 | 3 |
| 2 | Scientific and research practice (first) | 4.5 | 3 |
| 3 | Scientific and research practice (second) | 6.0 | 4 |
| | Total | 15.0 | 10 |
| | Total for training of Masters | 120.0 | |

The recommendations being formulated by the authors aimed at the advancement not only of this program, but also Master’s professional development programs of other specialties. The conclusions and recommendations are based on the need in gradual transition of higher ecological education to a new model that will connect, develop and improve all the components of the process of higher education in the context of sustainable development of separate settlements and regions of Ukraine.

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Мета. Теоретико-методологічне обґрунтування ключових напрямів удосконалення програм професійної магістерської підготовки інженерів-екологів у контексті реформування системи вищої освіти в Україні та завдань сталого розвитку її регіонів.

Методика. Теоретичною основою дослідження слугували фундаментальні положення теорії навчання та концепції вищої освіти, завдання нової політики України в галузі вищої екологічної освіти, праці вітчизняних і зарубіжних учених з питань підвищення якості системи освіти магістерського рівня, результати узагальнення українського досвіду щодо створення галузевих стандартів професійної освіти для екологічних спеціальностей.

Результати. Доведено необхідність системно-синергетичного підходу, відповідно до якого магістерська навчальна програма розглядається як гнучка й динамічна сукупність взаємопов'язаних дисциплін, що повинна відповідати мінливим ринковим потребам і сучасним завданням розвитку держави; що зміст і структура магістерської програми повинні бути адаптовані та збалансовані з мінливими потребами ринку праці та специфічними завданнями зі сталого розвитку певного регіону, урахувавши існуючу наукову базу, досвід і навчальний профіль конкретного університету.

На основі аналізу сучасних поглядів на місію вищих навчальних закладів і стратегічних завдань реформування вищої освіти в Україні показано, що магістерська програма з професійної освіти екологів повинна бути більш гнучкою та ефективною, тобто сприяти переходу всього процесу вищої екологічної освіти на нову модель, яка буде пов'язувати, розвивати та вдосконалювати всі складові процесу вищої професійної освіти в інтересах сталого розвитку окремих населених пунктів і регіонів.

Наукова новизна. На відміну від існуючих підходів, методика, що запропонована, спирається на принципи міждисциплінарного підходу, посилення варіативної частини програми, поглиблення профілювання й пріоритизація дослідницької практики, що забезпечує комплексність і динамічність розвитку магістерських програм з фахової освіти, зокрема для екологічних спеціальностей.

Практична значимість. Реалізація пропозицій буде сприяти підвищенню відповідності кваліфікаційного рівня випускників інженерів-екологів поточним потребам ринку праці в контексті сталого розвитку конкретних регіонів.

Ключові слова: сталий розвиток, екологічна освіта, програми магістерської підготовки

Цель. Теоретико-методологическое обоснование ключевых направлений совершенствования программ профессиональной магистерской подготовки инженеров-экологов в контексте реформирования системы высшего образования в Украине и задач устойчивого развития ее регионов.

Методика. Теоретической основой исследования послужили фундаментальные положения теории обучения и концепции высшего образования, задачи новой политики Украины в области высшего экологического образования, труды отечественных и зарубежных ученых по вопросам повышения качества системы образования магистерского уровня, результаты обобщения украинского опыта по созданию отраслевых стандартов профессионального образования для экологических специальностей.

Результаты. Доказана необходимость системно-синергетического подхода, в соответствии с которым магистерская учебная программа рассматривается как гибкая и динамическая совокупность взаимосвязанных дисциплин, что должна соответствовать меняющимся рыночным потребностям и современным задачам развития государства, а содержание и структура магистерской программы должны быть адаптированы к меняющимся потребностям рынка труда и специфическим задачам по устойчивому развитию определенного региона, учитывающая существующую научную базу, опыт и учебный профиль конкретного университета. На основе анализа современных взглядов относительно миссии высших учебных заведений и стратегических задач реформирования высшего образования в Украине показано, что магистерская программа профессионального образования экологов должна быть более гибкой и эффективной, то есть способствовать переходу всего процесса высшего экологического образования на новую модель, которая будет связывать, развивать и совершенствовать все составляющие процесса высшего профессионального образования в интересах устойчивого развития отдельных населенных пунктов и регионов.

Научная новизна. В отличие от существующих подходов, предложенная методика опирается на принципы междисциплинарного подхода, усиление вариативной части программы, углубление профилирования и пріоритизации исследовательской практики, что обеспечивает комплексность и динамичность развития магистерских программ по профессиональному образованию, в частности для экологических специальностей.

Практическая значимость. Реализация предложенных мероприятий будет способствовать улучшению соответствия квалификационного уровня выпускников инженеров-экологов текущим потребностями рынка труда в контексте устойчивого развития конкретных регионов.

Ключевые слова: устойчивое развитие, экологическое образование, программа магистерской подготовки

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