

Substantiating Standards for Training PhDs in Technical Universities of Ukraine (Case Study of the National Mining University, Dnipro, Ukraine)

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Abstract. The paper focuses on substantiation and implementation of the standards of the scientific and educational programme for training PhDs in technical sciences into the process of research engineers' instruction at NMU. The template curriculum has been developed with due regard to the holistic education paradigm and the synthesis of professional, social and worldview competences. PhD training is based on scientific and educational programme intended to build up integral, general and professional competences of young scholars. The syllabus for the course "Philosophy of Science and Fundamentals of Professional Ethics" has been compiled as a worldview foundation for shaping the mind of a scholar in technical sciences according to the topical issues of co-evolutionary development.

Keywords: Doctor of philosophy in technical sciences · Holistic education
Coevolution · Scientific and educational programme
General and professional competences · Philosophy of Science

1 Context

Before 2016, post-graduate education in Ukraine was regulated by the standards of the Soviet period. The Law on Higher Education of 2015 established three levels of higher education in Ukraine following the European framework of qualifications: Bachelor, Master and PhD. As of today, the level of PhD has been represented in Ukraine by the degree of the Candidate of Sciences that is essentially different from the PhD degree. The previously accepted system of post-graduate studies had serious drawbacks:

1. Post-graduate programme lasted 3 years. During this period, PhD students were required to publish the results of their research and to defend a dissertation, which is insufficient for all-round accomplishment of a scholar and completion of a cutting-edge scientific research.
2. In the process of studying, a postgraduate did not acquire necessary training in methodological, organizational and worldview domains. 90% of postgraduate study time was allocated for writing a dissertation, which resulted in significant deterioration of its quality, since there was no adequate preparatory training. The former

postgraduate training pattern did not include practical component, which affected pragmatic aspects of postgraduate research and limited the career trajectory of a scholar after the dissertation defense.

3. Before 2016, postgraduate programmes were not based on the competence approach, which significantly hampered the career growth of prospective scholars in terms of wide range of science socio-cultural integration.
4. The worldview approach to post-graduate training was based on the Soviet tradition of science ideologization, which manifested itself in teaching the course of “Philosophy” mostly in the narrow materialistic framework. Such approach was counteractive to broad-minded attitudes and prospective thinking of a scholar. Thus, the situation called forth cardinal changes in training modern PhDs in our country. In view of the absence of standards for training PhDs in Ukraine, there arises a need to develop standards and curriculum for educating specialists of this level in accordance with requirements of the modern European science.

2 Purpose or Goal

The purpose of the research is to substantiate the standard for training PhDs on the basis of the case study conducted at the National Mining University (NMU). The tasks of the research are: to present the general concept of training PhDs, to define the key professional, social, personal and creative competences required for this level, to showcase the ultimate design of scientific and educational programme and curriculum for training PhDs at NMU. We also aimed to introduce the syllabus for the course “Philosophy of Science and Fundamentals of Professional Ethics” as a worldview foundation for scientific research in engineering domain.

3 Approach

The present research is based on the paradigm of holistic education, which is understood as synthesis of the scholar personality development in the form of a unity of professional, social, and worldview competences. The latter play the key role in substantiating the scientific and educational programme for training PhDs in technical sciences, because they are instrumental in setting evolutionary goals and formulating innovative approaches in science.

In order to implement the system of PhD training described above, we have used the inter-disciplinary and competence approaches.

4 Substantiating of PhD Competences in Technical Sciences

One of the fundamental tasks of science is to qualitatively change the forms of human life. The scientist of the XXI century is becoming more and more responsible for the consequences of transformations brought about not only in material, technical and social spheres, but also in the environment and the surrounding world as a whole. The

world is predominantly viewed as an entity, while the man and his socio-cultural space is organically embedded in its holistic picture. Hence, it is necessary that scientific research involve not only professional discovery but also conscious approaches to understanding evolutionary prospects of man and society development. The essence and character of scientific activity are determined by the ability to consciously set goals, which is based on the value and moral orientation of a scholar, understanding of their own possibilities, aims, tasks and responsibility for the transformative activity. Thus, a new scientific and educational programme for training PhDs in technical sciences is aimed at ensuring successful activity of a scientist in line with all world-view, organizational and professional imperatives of our time. In view of the above, we have compiled a significantly revised curriculum for training PhDs in technical sciences at NMU on the principle of complementarity of general and professional competences. Accordingly, the main task of training PhDs in technical domain is to form an integral competence on the basis of interdisciplinary approach to the study programme on the whole. Integral competence of PhDs in technical sciences implies ability to conduct innovative research resulting in creation of new holistic knowledge in keeping with co-evolutionary processes related to man, nature and society.

4.1 General PhD Competences in Technical Sciences

Integral competence is a basis for building up general competences of a Doctor of Philosophy which are universal for all areas of study and specializations:

- interactive communication with broad scientific community and researchers in scientific and professional spheres;
- starting up innovative complex projects, ensuring leadership and ultimate autonomy during their implementation;
- social responsibility for the results of making strategic decisions;
- self-development and self-improvement, responsibility for teaching other people;
- generating new ideas;
- mastering scientific methodology;
- mastering pedagogical methodology;
- presentation and discussion of scientific results in a foreign language according to specifics of the study area in oral and written form;
- full comprehension of foreign scientific texts in the field of specialty;
- formation of a systemic scientific worldview;
- development of professional ethics and general cultural erudition.

Considering the competences listed above, we can conclude that in the result of training, a prospective Doctor of Philosophy should possess scientific, methodological, philological, presentational, communicative, ethical abilities, which are based on the systemic scientific worldview and high level of analytical and abstract thinking. It is interdisciplinary approach to the development of general competences that contributes to the formation of a mature mind of a scholar striving for evolutionary prospects of science. It should be noted that general competences are the fundamental basis for training PhDs in technical sciences at NMU which comprise the essence of scientists' education.

5 Professional PhD Competences in Technical Sciences

Professional PhD competences derived from general competences are differentiated according to the kinds of professional activity: research, innovation, project design. Let us consider professional competences for the scientific and educational doctorate programme in “Engineering Mechanics”.

Professional competences in research:

- mastering terminology of applied mechanics;
- learning the history of development and present state of scientific knowledge in specialty;
- learning principal conceptions of applied mechanics;
- understanding theoretical and practical problems of applied mechanics;
- learning conceptual and methodological knowledge in improving technological processes of manufacturing machines and equipment, scientific research and professional activity on the borderline of different areas;
- conducting own scientific research yielding the results characterized by scientific originality in theory and practice;
- solving complex problems in the field of applied mechanics
- applying modern information technologies in scientific and pedagogical activity.

Professional competences in innovative activity:

- implementing critical analysis, assessment and synthesis of new and complicated ideas in development of technological processes related to manufacture of machines and equipment;
- solving complex problems in the field of innovative activity;
- skills of registering intellectual property rights;

Professional competences in project design:

- presenting ideas for financing scientific research;
- development and realization of the projects, including one’s own research, which allow to revise the existing knowledge and create new holistic knowledge, as well as professional practice in the field of developing technological processes related to manufacture of machines and equipment;
- management of scientific projects.

6 The Curriculum of the Scientific-Educational Programme for Training PhDs in Technical Sciences at NMU

The curriculum of the scientific-educational programme for training PhDs in technical sciences at NMU based on the competences described above is intended to last 4 years (not 3 years as before). The scientific-educational programme comprises 40 credits, of which 27 credits constitute the compulsory part common for all the doctorate students

of the university, and 13 credits go for the variant part, which is determined by the specialty specifics and the free choice of PhDs. Table 1 presents the curriculum of the scientific-educational programme for training PhDs in technical sciences at NMU.

Table 1. The curriculum for training PhDs in technical sciences at NMU.

Kind of educational activity	Credits
I. Cycle of general training	27
Cycle of humanities (university)	13
Philosophy of science and fundamentals of scientific ethics	5
Foreign language for professional purposes	5
Psychology of scientific research	3
Cycle of general scientific disciplines (faculty)	6
Mathematical modeling utilizing computer technology in research	3
Inventing and registering intellectual property rights, evaluating economic efficiency of innovative developments	3
Practical training	8
Skills of effective presentations	2
Scientific self-management	2
Preparation of scientific articles, abstracts, conference and scientific seminars reports	2
Teaching practice	2
II. Cycle of professional training (department)	13
Compulsory part	3
Scientific and innovative tasks and problems of the applied mechanics	3
Variant part	10
Disciplines of the student free choice (block 1)	10
Forming algorithms for statistical control of quality in machine building	5
Trends in development of computer methods related to optimization of technological processes in machine building	5
Disciplines of the student free choice (block 2)	
Tasks and problems of using virtual research devices on the basis of geometric programming	5
Modern methods of technological processes optimization	5
Disciplines of the student free choice (block 3)	
New approaches to studying wear and durability of cutting tools	5
New approaches in cutting processes research	5
Qualification thesis completion	
Total:	40

Lists of disciplines in different blocks of the curriculum are compiled by various structural units of the university. Thus, humanities of the general training cycle are the same for all the specialties of the university, while the cycle of general scientific disciplines is designed by the faculty. According to the curriculum, the disciplines of the compulsory and variant blocks of the professional training part are suggested by the related department.

The syllabus for the course “Philosophy of Science and Fundamentals of Professional Ethics” has been developed within the frames of scientific and educational programme for training PhDs in technical sciences by Philosophy and Pedagogy Department of the National Mining University. The objective of this discipline is to form holistic ideas about the role of science and a scientist in society development, as well as about the history and prospects of science development in evolutionary civilization processes. This discipline is compulsory for all the specialties and functions as a worldview and methodological basis for forming the mind of the future scientists.

7 Conclusions

Development and implementation of the standards for training PhDs in technical sciences on the basis of holistic educational paradigm will allow to optimize preparation of research engineers in the context of integral formation of professional, social and worldview competences, which contributes to the enhancement of axiological component of engineering and its evolutionary socialization.

Reasons focus on competence approach in education:

- trends in integration and globalization of the world economy;
- the need to harmonize the architecture of the European higher education system under the Bologna process;
- the paradigm shift of higher education: from paradigm of knowledge to paradigm of competency - abilities successfully realized in modern society
- in this regard, the transition to 4-year training provides an opportunity to master fundamental and special disciplines (the first two years) and successfully carry out scientific research (the third and fourth year), as practical realization of the competences of the scientist.

Qualitative content and organization changes in designing scientific and educational programme for training PhDs in technical sciences, which aims at building up integral, general and professional competences of a researcher, have laid the basis for the Ministry of Education and Science of Ukraine standard of PhD training, which contributes to integration of Ukrainian science into European space.