ORGANIZATIONAL AND PEDAGOGICAL FUNDAMENTALS OF PROFESSIONAL TRAINING OF ENGINEERS IN THE FIELD OF NANOELECTRONICS IN UK UNIVERSITIES

ABSTRACT
The article deals with the organizational and pedagogical principles of the professional training of future nanoelectronics engineers in UK universities. There has been substantiated a number of general didactic and specific principles of the professional training of future nanoelectronics engineers, which facilitate the concretization of content, goals, and tasks of professional training; enhancing the efficiency of the forms and methods of organizing academic activity and its effectiveness; the development of general theoretical and methodological bases of the effective forming in the future engineers of the system of professional knowledge, the skills to use it in their professional activity and deepen it throughout life; skills to masterly use the full arsenal of means and techniques in the process of solving any professional and technical issues. There has been characterized the structure of engineers' training curricula, which envisages the study of core, elective and optional subjects and writing a Master's dissertation. There have been examined the stages of the study organization at the Masters' schools: the practical ones (lectures and seminars) and the theoretical (research) ones. There have been defined the peculiarities of the nanoelectronics specialists' practical training.

Key words: UK, professional training, nanoelectronics engineer, learning content, educational principles, practical training, control forms.

INTRODUCTION
It is expedient to justify organizational and pedagogical principles of professional training in the field of nanoelectronics on the basis of legislative and regulatory instruments, research and instructional methodology, structural features of the system of university education in Great Britain, public demands for professional training in the field of nanoelectronics and their professional activities in terms of the European integration processes of scientific inquiry.

Organizational and pedagogical principles mean strategic goals, objectives, directions, principles, semantic, operational, diagnostic, and prognostic components of professional experts’ training in the field of nanoelectronics. Justification of main principles of professional experts’ training in the field of nanoelectronics is carried out by British researchers taking into account British, as well as world tendencies of development of pedagogical science, education, culture, and modern international reality. British society is concerned with the radical changes of priorities that take place both in the system of mankind and British society values. On the one hand, we can see the transformation of British society in the direction of information, production technologizing, the direction of mastering knowledge and skills and on the other hand – conservatism, appreciation of history, culture and
national traditions that suggest transition to humanistic paradigm directed at the personal
development and creative self-actualization of the person in culture and society.

THE AIM OF THE STUDY

The article has as its object to study organizational and pedagogical fundamentals of
professional training of nanoelectronics engineers in UK universities.

THEORETICAL FRAMEWORK AND RESEARCH METHODS

The analysis of the resources has shown that during the last decades national
scientists actively conducted comparative-pedagogical researches of the professional training of
specialists in the developed countries of the world – Great Britain, Canada, Germany,
Scandinavian countries, the USA, France, etc. General issues of studies and education,
reformation of engineering education in Great Britain, integration and globalization
processes of university education have been investigated by A. Barbariha, N. Bidyuk, O. Hoya,
N. Mukan, L. Pukhovska, O. Serheyeva, V. Tretko and others. Of considerable interest are
the results of UK researchers (N. Bigtem, N. Wolliman, V. Hann, D. Jonassen, G. Evans,
G. Kerol, T. Kerry). The problems of nanoelectronics engineers training in Ukraine were
investigated by Yu. Poplavko, O. Borysov, V. Ilchenko and others.

For the realization of aim of the study there was used the complex of interconnected
methods of research, in particular: analysis, synthesis, comparison and generalization – for the
study of the works of national and foreign scientists, official and normative documents; interpreting-
analytical one, that furthered the conceptual analysis of literary, documentary and other English-
language sources with the use of interpretation, systematization, comparison and generalization.
Methodological basis of the research lies in the philosophical ideas of education
humanization and internationalization, scientific approaches, didactics principles of studying.

RESULTS

Justification, specification of the known principles of professional experts’ training
in the field of nanoelectronics and logic of presentation that contribute to specifying the
content, purpose and objectives of training; more effective forms and methods of education
and its effectiveness; development of general theoretical and methodological foundations of
effective formation of specialists of professional knowledge and skills to apply in their
professional field that could be life-long enhanced; ability to skillfully use the full arsenal
of tools and techniques in the process of resolving any issues of professional and technical
matter (Poplavko, Borysov, Ilchenko, 2010).

Since the defining feature of professional training of the Masters of International
Relations is a comprehensive study of the theory and practice of nanoelectronics, research
activities, practical orientation and activity approach to the implementation of its content,
the priority didactic principles are those that are aimed at ensuring the quality of training
and the effectiveness of these objectives and goals. We identified a number of general
pedagogic traditional didactic principles that are crucial in shaping the goals and objectives
leading in the implementation of training of future professionals in the field of
nanoelectronics. They are: variability principle, objectivity, integrity, scientific approach,
 systematic, consistency, accessibility, openness, flexibility, diversity of learning, mobility,
organization of work, continuity, structuring, forecasting, advanced training, validity of
knowledge, integration of science and education, electivity, communication theory and
practice, individualization of learning.

The effectiveness of professional expert’s training in the field of nanoelectronics
promotes integration of general pedagogic and specific didactic principles which one should
take into account in professional preparation of experts in the field of nanoelectronics, including: career specialization; priority of self-education; inter-disciplinary integration; communication training and research activities; professional and motivational orientation training for research activities; feedback; systematic formation of research skills.

The study of the nature of each of the principles made it possible to distinguish those that have been improved with specific educational process of British education and applied in the implementation of the content and objectives of the training of future specialists in the field of nanoelectronics. Adherence to these principles and their adequate selection, design and specification of the priority tasks of training requirements of science, information civilization, practice and society promotes scientific and creative abilities of students, relevance of the content, forms, methods and means of education and prediction of outcomes and so on.

Professional training in the field of nanoelectronics in higher education in Great Britain is based on interdisciplinary, acmeological, scientific and learner-centered approaches, as well as on the principles of integration of science and practice, scientific, professional orientation.

However, we should note that the guiding principle of the content of professional training is the principle of variability, which allows to take into account the specifics of professional training and specificity of the educational process (variation of curriculums content, courses, integration of content of professional training; stratification in the way of implementation of the content, forms and methods, logical unity and continuity in training specialists in the field of nanoelectronics and their practice, continuity and succession of the stages of the educational process, accessibility and learner-centered focus of the educational process). The principle of focusing on the development of scientific-practical sphere of personality is one of the leading principles of practical implementation of the knowledge obtained by specialists in the field of nanoelectronics that logically combines consistency, continuity, availability and integrity of training and education of the individual, provides a unique environment for direct contact with the participants of the educational process, practical protection of their interests, needs and demands. The undeniable value of this principle in the educational process is defined by a significant positive effect on deep assimilation of experts in the field of nanoelectronics of the leading ideas and concepts of the acquired knowledge and skills in general; the development and improvement of practical activity.

The principle of continuity contributes to the improvement of practical activity. The principle of continuity contributes to the formation among experts in the field of nanoelectronics of constant interest and need for constant updating of knowledge and improvement of practical skills. Implementation of the interdisciplinary approach is aimed at creating conditions for effective awareness of experts in nanoelectronics of unity and interrelation of socio-cultural and educational environment in the process of integrated courses. Integrative principle is one of the guiding principles of designing the content of professional training. There are two major areas of implementation of its content: classification, generalization, relevance, didactic unity and logical system of specialized knowledge in the content of the curriculum of the biding and elective cycles.

On the basis of curriculum of the known universities in Great Britain (Cambridge, Oxford, Southampton, Edinburgh, Leeds, Nottingham, Birmingham, Manchester, Sheffield, King's College London, University College London) (UK universities' sites) it was found that the content of education is focused on professional, scientific and research training, promising career opportunities and professional development of specialists in the field of nanoelectronics. Professional training in the field of nanoelectronics implies thorough
basic, practical and scientific training through the integration of general, professional and specialized knowledge. Variation of the educational programs, free choice of subjects is a traditional feature of higher education in Great Britain. The structure of the curriculum involves the study of binding disciplines (100-120 credits for Bachelor program and 45 credits for the Master program), elective and optional courses (60–80 credits – Bachelor program, 15–60 – Master program) and writing a master's thesis (30 credits). Elective courses are divided into courses of restricted choice and of free choice. The main difference is that a student gets credits for the elective courses, as opposed to optional courses.

Flexibility of individual programs is provided not only with a choice of courses, but with some of their parts. The latter became available owing to the modular principle, which means that the course is divided into elements that make up relatively independent parts (modules).

The implementation of individual education plans is provided with block-modular system of program construction, which provides the ability to perform various intelligence operations and to use this knowledge in solving educational problems. Usually the curricula contain consecutive blocks: information, testing-information (check of the mastered knowledge), correction and information (in case of incorrect answers – additional training), problematic (solving of problems based on acquired knowledge), unit testing and correction. Curricula are developed in a modular style aiming at integration courses and logical distribution of binding blocks and optional subjects.

Modular training is one of the most integrated systems approaches to learning, which provides high technology implementation of the didactic process. The essence of the didactic process that is based on modular technology is aimed to ensure that the training content is structured into autonomous organizational and methodological components (modules). Module is a training block that covers the conceptual unit of study material. The content and scope of modules on the other hand vary depending on the profile, level differentiation of students and didactic purpose. This approach allows to create the conditions for the selection of individual trajectories of the educational course.

Many universities of Great Britain use the combination technique of modular and integrated education. This principle of creating education programs enables to change the selected entry in the profession relatively easy, the courses that were required for one specialty may be counted as elective ones for another. The possibility to choose objects from different blocks provides flexibility of the entire system of training in the field of nanoelectronics.


Theoretical phase involves writing a master's thesis project (15–25 thousand words) during 10 months. At this stage, masters cover a number of research strategies and methods, including text analysis, research methods, and the use of modern media resources, statistical, deductive modeling and computer simulation technology. The success of learning research program depends on the ability to find a supervisor and make him interested in the problem of the research project (Trotsky, 2013).
The peculiarity of the education at the Master’s program is to create the right
conditions to continue research careers, including learning according to the MSc program
Nanoelectronics and Nanotechnology, which is a guide to obtaining PhD degree. Obtaining
MSs Degree gives job opportunities in leading companies in the field of electronics. The
payment for the entire course is about £ 9,000-12,000 for British citizens and £ 20,000-
25,000 for foreign students (UK universities’ sites).

After graduating and obtaining Master’s degree students of the specialty
“Nanoelectronics and nanotechnology” should be able to:
– analyze and solve problems in the field of nanoelectronics and nanomaterials using
  integrated multidisciplinary approaches;
– formulate hypotheses and check them;
– plan and conduct experimental research;
– analyze the results of the study;
– express reasoned arguments and synthesize information;
– use information and communication technologies for search and presentation of
  information;
– work in a team to achieve a common goal (QAA).

The creative combination of methodological approaches and principles promotes
professional competence of specialists in the field of nanoelectronics, including the following
components: cognitive (integrated socio-cultural knowledge, knowledge of terminology,
industry knowledge); information and analysis (search, analysis, classification, presentation
of information, information technology, development of cognitive activity, critical, logical,
divergent associative, analytical thinking types); operational and practical (professional,
academic abilities and skills, behavioral responses, mastering the productive ways of foreign
professional communication, the use of discursive ways of expressing information, dialogue
strategies); motivation (objectives, formation of positive motivation, skills’ development,
result-oriented, communication strategies, reflection, professional development, self-
improvement and self-fulfillment).

CONCLUSIONS

The study of the British experience makes it possible to conclude that the training of
competent professionals in the field of nanoelectronics should focus on obtaining
professional knowledge, professional formation and training of a professionally meaningful
personality traits that are necessary for successful application of knowledge and skills in
professional activity, getting professional experience, the formation of professional ethics
and getting motivation for further professional development. Control forms of academic
achievements of the experts in the field of nanoelectronics is based on a balanced
combination of several criteria such as: preparation of research papers, passing exams,
writing reviews, preparation of reports, essays, dissertations; oral and written assignments,
group and individual work; evaluation by teacher, by classmates or self-assessment.
Different types of assessment are meant to verify the degree of mastery of key knowledge
and skills, including: the ability to organize and convey briefly the content of a number of
sources; to use a significant amount of knowledge, to demonstrate understanding of basic
concepts; to create logical response; to argue and to draw conclusions and generalizations,
as well as to express them orally and in writing. The forms of assessment are aimed to test
the ability to organize work in specified time frame; to handle texts, to analyze arguments,
using specific examples. A thesis in the final year, master’s course work or bachelor work
estimate students’ ability to carry out their research independently. The peculiarities of
practical training in the field of nanoelectronics is an internship at the university and in the leading companies of the high technology industry (IBM, ARM, Microsoft Research, Imagination Technologies, Nvidia, Samsung, Google), research institutions, participation in international programs and projects, internships abroad.

The use of the progressive ideas of UK experience will assist in the improvement of the organization of future nanoelectronics engineers' professional training in Ukraine. Further directions of research may include the analysis of the features of the practical training of nanoelectronics specialists in Great Britain.

REFERENCES