

Work with Young Researchers: Experience of Zaporizhzhya National Technical University

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Abstract—The systematic presentation of the main methodological principles, as well as developments of ZNTU in the organization of work with young researchers are considered. Analysis of the needs of young researchers allows us to highlight the key problems of young researchers: the lack of moral motivation to participate in scientific work, the lack of knowledge of research methods, the problem of choosing supervisor, research topic and industrial partner, the difficulty in finding financial support for research.

Keywords—Young researcher, talented youth, research work, students, Zaporizhzhya National Technical University.

I. INTRODUCTION

Zaporizhzhya National Technical University (ZNTU) is the largest and oldest scientific and educational center in the Zaporizhzhya region, Ukraine.

The university has more than 800 scientific-pedagogical workers, including 50 habilitated D.Sc. and 400 Ph.D. The ZNTU provides training of 11000 students at university and its colleges, 80 post-graduate students, and 7 post-docs. The number of young researchers is 260, including 73 Ph.D. [1]

Annually ZNTU performed 30 scientific projects with total financing over 3,5 million UAH. University publishes 24 textbooks, 10 monographs, 4 scientific journals, and over 2300 scientific articles and 30 patents and copyright certificates each year. University specialists participate every year in 400 conferences and seminars, where published more than 1,000 reports [1].

A significant number of young researchers necessitate organization work with them in ZNTU on a permanent basis. Working with young researchers conducted at the level of teacher, department, and university. The Research Sector and the Council of young scientists and specialists (CYSS) of ZNTU play a special role in the coordination of this work.

The purpose of this article is a systematic presentation of the main methodological principles, as well as developments of ZNTU in the organization of work with young researchers.

II. GENERAL METHODOLOGICAL PRINCIPLES OF WORK WITH YOUNG RESEARCHERS

As the main purpose of education is to create conditions for personal development and creative fulfillment the nurturing and development of creative abilities of students is one of the important tasks of higher education.

Talented students and young researchers are characterized by high development thinking, by lasting remembering of educational material, by developed self-control skills in training activities, and by high operability. They have high mental activity, increased susceptibility to mental activity, eccentricity, freedom of self-expression, richness of imagination, formation of different types of memory, reaction time, and the ability to question scientific understanding of certain phenomena, stereotypes and dogmas [2].

The university has to identify the level of development of talented students and their potential to help young people to understand themselves, to create conditions for the mobilization of personal resources (psychological mobilization), and to help develop themselves. For this it is important to develop the creative potential of students, educate students interest in knowledge,

independence in learning, to expand horizons, to form persistence in achieving this goal, to teach them to think critically, to quickly navigate in difficult professional situations and find the right solution.

To realize this the University actively use such forms of work as scientific groups, conferences, seminars, trainings, intellectual competitions, contests and olympiads in which young researchers gain new knowledge and experience, create new research and engineering and projects, cooperate other and with supervisors, learn to write scientific articles and to make public presentations.

One of the most important tasks of training young researchers is to develop their interest in science and research. To do this it is needed to form such student focus on learning activities, which is based on the intellectual and cognitive motivation, creative thinking, the manifestation of willpower, commitment to long-term hard work associated with the independent actions in addressing the goal.

The presence of internal and external reasons of students to intellectual activity is an essential factor for effective research. Internal motivation for research activity can be the satisfaction obtained from the process of finding a solution to the problem of self-selection of topics and methods of solving problems. External motivation can be a variety of incentives: material rewards, scholarships, successful presentation at the conference, the publication of articles, preparation of recommendations for further study in graduate or postgraduate, high evaluation of the results of research [2].

In the development of student research work skills the teacher plays an important role. It consists in the organization and provision of guidance, in the direction of search and research activities of student, providing the ability to effectively overcome the difficulties, the intellectual stimulation of initiative and creativity.

Intelligent self-development contributes to the gradual transition from a joint action with the teacher informative for independence from the unconscious to the conscious and targeted actions. A necessary condition for self-development is the establishment of links between the needs, motives and objectives of the search operation, the complication of the operating aspects of the activity, the allocation of the generalized methods of action, sequence of operations, development of skills of self-regulation on the basis of intellectual reflection [3].

III. RESEARCH WORK WITH STUDENTS

Scientific research and innovative work of students is an important area of training of future scientists and high qualified specialists and is an inseparable part of the joined process: the educational and scientific-innovative. The research work of students stimulate their intellectual activity, promotes creativity, which consists not only in the ability to generate original ideas in a setting of new challenges, but also be aware of the gaps and contradictions, to abandon the stereotypical ways of thinking [1].

A distinctive feature of the researcher is the desire to understand and explain the phenomenon, identify the laws and patterns that lie at its core. The research work of students meant a special kind of self-learning activities, aimed at solving specific problems related to the lack of existing knowledge and skills, built on the actualization of the individual mental experience of every student, strengthening individual intellectual resources, encouraging self-organized learning activities [3].

In the direction of involvement of students to scientific work in ZNTU the departments and laboratory of pre-doctoral training and working with the talented young people actively and fruitfully cooperate.

Student research activities include competitions in disciplines and specialties. Olympiades provide an opportunity to identify the level of training and give impetus to creative development. Students under the guidance of teachers participate in international, national and regional Olympiads, competitions of scientific works and developments. Participation of students in

student contests of scientific works and scientific conferences it is one of the most pressing forms of involvement of students in research and the ability to find talented young people in research and disclosure of creative potential of university youth.

Recently, ZNTU students received prizes in International open olympiad on programming "KPI-open", International language and literary competition behalf of Taras Shevchenko, International Ukrainian Language Competition behalf of Petro Yatsyk, Ukrainian Student Olympiad on programming ACM, Ukrainian student Olympiads by specialties "Analogue Electronic Devices," "Safety", "Engineering Mechanics", "The Technology and Equipment of Welding", "Electrotechnical Systems", "Foundry of Ferrous and Nonferrous Metals", "Management of Organizations", "Organization of Road Traffic", "Transportation Systems", "Radio electronic Devices", "History of Ukraine", "Computer Science", "Design", Ukrainian competition of student scientific works in the following directions: "Economics of Transport", "Welding", "Electrical Engineering", "Motors", "Marketing", "Metallurgy" [1, 4].

Each year the university held a competition for the best student scientific work in 10 categories. The works, whose authors will be winners of university contest, will be sent to All-Ukrainian competition of student papers.

Competitions LikeIT "The future of IT people" held for young IT professionals and programmers in the form of programming marathon (hackathon). Competitions are held in the categories: desktop and web. Continuing to 24 hours of non-stop, in a competitive environment, with minimal time to rest, participants create their own projects. At the end of the marathon team will present its findings and jury evaluates the relevance of ideas, creative approach to problem solving and skills of participants [1].

European BEST Engineering Competition (EBEC) held jointly with ZNTU BEST (Board of European Students of Technology) students of technical universities in Europe [5].

Engineering competition is a project that includes the task of designing and modeling, analytical case studies, debates and negotiations; is an opportunity for students to express themselves and realize their wildest design ideas, share thoughts and ideas, to communicate with partner companies.

The aim of the competition is to promote engineering in Ukraine by creating favorable conditions for its emergence and development. It creates conditions for competition of ideas of participants in the race because it is born and effective creative problem solving. In addition, competition within the engineering students of technical universities the opportunity to develop and realize their ideas through collaboration with companies and communication with the European educational community. Providing contact students, universities and partner companies competition, we create a unique platform for communication, and our project - a new wave of engineering in Ukraine.

Competitions are held in several stages: the local stage at one university level, the national stage at the country level or regional stage among neighboring countries. The winners of the local stages are involved in the national / regional stages, the winners of national / regional stages enter the final stage of European engineering competition. The goal of each stage is to create, to design innovative, creative solution, struggling with a lot of restrictions. The competition involved teams of 4 people.

The categories of competition:

- Team Design is a solving specific technical task by team for a limited period of time. The result of the competition is the availability of a device that performs the functions necessary to solve the problem. A company that provides tasks for this category can cover various areas of engineering disciplines: electrical engineering, electronics, mechanics, hydraulics, radio and so on. Usually the process of solving and presenting the results are quite dynamic and spectacular for its coverage of representatives of the media;

- Case Study is a solving the analytical problems, a detailed study of a particular object, problems, a process that has a clear temporal and spatial boundaries. Typically, as the issue of

administrative or technical field. The company provided all information needed to solve this problem, the problem may be specific nature concerning the problems and development company. The results of research presented by a team as computer presentation. This type of collaboration allows the company, simplifying the selection procedure, to communicate with the best three students of Ukrainian universities.

The development of task involved a group of organizers. In some cases together with providing task. Other organizers do not know the tasks. Organizers do not affect on decision-making results. The only exceptions are those who are members of the jury.

The jury may include as representatives of partner events that provide a specific task, and organizers involved in development tasks, guest lecturers. Decisions are evaluated on criteria such as compliance of solutions (model) to task requirements; creativity and aesthetic performance, teamwork of participants.

IV. COUNCIL OF YOUNG SCIENTISTS AND SPECIALISTS OF ZNTU

Council of young scientists and specialists of ZNTU (CYSS) is a voluntary, self-governing public body under the administration ZNTU and has a functional and advisory character [6].

CYSS created to bring together young scientists of Zaporizhzhya National Technical University, expressing their interest in the professional sphere, promoting the solution of scientific problems and protect the social interests. CYSS created on the initiative of young scientists of ZNTU and operates in ZNTU.

As young scientists of ZNTU are considered the Dr.Sc., Ph.D, doctoral and Ph.D students, post-graduate and master students, scientific-pedagogical staff and specialists of ZNTU that up to 35 years old (PhDs and Dr. Sc. students – up to 40 years) who are engaged in research and educational work.

The work of CYSS based on the current legislation of Ukraine, ZNTU Charter and the principles of voluntariness, equality and self-government. The CYSS activities coordinated by administration of ZNTU through vice-rector for scientific work. Head of CYSS of ZNTU is a member of the Academic Council and the Scientific and Technical Council (STC) of ZNTU. The members of the CYSS Presidium included into the councils of institutes and departments, at least one representative in each institute and faculty. The highest collegial body of the CYSS of ZNTU is the general meeting. The executive body of the CYSS of ZNTU is the Presidium of the CYSS.

CYSS operates in the following areas [7].

1) Organizational work: questioning of young researchers and specialists, bringing them to the membership and work of the board, election of the Presidium and the Head of CYSS, the meetings of the Presidium of CYSS, involving members of CYSS to work in the ZNTU Conference of Staff, the Academic Council and the Scientific-Technical Council of ZNTU, department and faculty councils, reporting on the CYSS activities on the ZNTU Academic Council meetings, assembly, installation and maintenance of contacts with the councils of young scientists from other universities, regional councils of young scientists, the Ukrainian Council of Young Scientists and specialists of the Ministry of Education and Science of Ukraine, promoting the consolidation of young professionals in the ZNTU staff.

2) Information support of young researchers: the formation of an electronic database of CYSS members, informing CYSS members via email about conferences, seminars, scientific schools, as well as about competitions for grants with the support of Patent information department and Sector for talented youth of Scientific-research division of ZNTU, support of CYSS web page on ZNTU server, the publication of information on the structure, composition and activity of CYSS and information on grants and conferences, promotional descriptions of ZNTU development of young researchers.

3) Scientific work: holding campaign work among students for their involvement to the scientific work and to the subsequent graduate and postgraduate programs, facilitate the

preparation of dissertations by post-graduate students (providing them with the necessary scientific, methodological and organizational assistance, including organizing and conducting individual consultations and group seminars for post-graduates on the writing, formatting and defense of theses, measures to improve the effectiveness of post-graduate school, including the organization of public control of post-graduate students), support in the university for the conferences and seminars, attract young researchers to work in the organizing committees, promote the publication of works of young researchers in scientific journals and proceedings, involvement CYSS members with scientific degrees to the editorial boards of scientific publications of ZNTU, promote competitions of scientific works and subject Olympiads among young researchers, supporting young researchers to participate in contests and competitions, involvement CYSS members to the organizing committees and competitive commissions of subject Olympiads and contests in ZNTU, the public discussion and recommendations of young researchers to participate in competitions for grants, scholarships, and prizes, admission to Doctoral and Master studies, help young researchers in protecting innovation (consulting in writing and registration of patent applications), facilitation of the participation of young researchers in state budgetary and contractual research projects, assistance in organizing and conducting new scientific research, promotion in increasing access of young researchers to research resources, including scientific electronic libraries, supporting of young researchers for training in leading scientific and educational institutions of Ukraine and other countries, as well as participation in conferences and seminars.

V. STUDY AND ANALYSIS OF THE PROBLEMS OF YOUNG RESEARCHERS

To effectively plan activities on work with young researchers in ZNTU the questioning of young researchers [8] is regularly realized. Survey results are processed and analyzed by CYSS and scientific-research division of ZNTU. Results of the analysis are presented at the scientific-technical council and reported to the vice-rector for scientific work of ZNTU.

In the framework of analysis of the young researchers responses in recent years we select the following problems of young researchers:

- moral motivation to participate in scientific work;
- lack of knowledge and techniques of research principles and standards of scientific publications;
- the problem of choosing of supervisor and of research topic;
- difficulty in finding contact with industry, research detachment from practice;
- low level of foreign language skills of students and graduate students;
- the lack of effective medium for communication and joint implementation of research by young researchers of different universities;
- lack of financial support scientific work of young researchers;
- access to paid young researchers scientific digital libraries and databases of foreign scientific literature;
- low number of foreign publications of universities. Zaporizhzhya;
- payment of foreign publications in scientific journals and participation in conferences.

It is interesting to note that these results are consistent with the results of [3], which states that during the process of research, students face such difficulties: the inability to see the problem, the complexity of the formulation of goals, objectives, study difficulties drawing up a plan of work, allocation of time, the complexity of the information (search, inability to allocate the main thing in selected materials), inability to evaluate the results, the uncertainty and the fear of performance.

To ensure the sustainability and efficiency of research work of young researchers it is proposed to perform such activities.

1. Organization of annual citywide competition of scientific works of students and graduate students of higher educational institutions funded by the Zaporizhzhya City Council with

considerable financial incentives of participants. Promoting competition results in media owned by the City Council.

2. Implementation of grants to talented undergraduate and graduate students on research with financial support of Zaporizhzhya City Council by organizing the annual competition.

3. Conduct engineering competitions (as a means of popularizing science and technical creativity among students in Zaporizhzhya).

4. Development of program project for funding by Zaporizhzhya City Council of students participation in international conferences, payment for publishing articles in international scientific journals.

5. Professional orientation work among school students and college students on choosing a profession. Support of mass media owned by the City Council to popularize university representatives and specialties.

6. Develop an Internet portal for organizing joint execution of research by young researchers from different universities with the support of the international project "Centers of excellence for young researchers" (CERES), funded by the Tempus programme of the European Commission. Providing organizational and informational support for the project from Zaporizhzhya City Council.

7. Continue the practice of setting annual scholarships of mayor of Zaporizhzhya. Increasing the number of scholarships and their scope. Organization of open competition for these scholarships with the participation of students and young researchers.

8. Hold a contest-exhibition of research works of students (for various sections) under the auspices of Zaporizhzhya City Council with the display of the results in the media (television, newspapers, Internet sites) and with participation of businesses, university and college students, and school children.

Formation of research abilities and skills, mastering the methods of scientific work, along with the training and research work of students is carried out by including them in active extracurricular research work in student scientific circles, in the preparation and defense of research work at student conferences, competitions. The effectiveness of this type of work is the possibility of an individualization of training and the construction of individual trajectory of development taking into account the experience of the mental and cognitive stimulation, involving him in different kinds of intellectually-search activity [3].

VI. CONCLUSION

The article gives a systematic presentation of the main methodological principles, as well as developments of ZNTU in the organization of work with young researchers.

For the training of young researchers should be used such forms of work as scientific groups, conferences, seminars, trainings, intellectual competitions, contests and olympiads in which young researchers gain new knowledge and experience, create new research and engineering projects and cooperate with each other and with supervisors, learn to write scientific articles and public appearances. It is also important to pay attention to motivating young researchers to give them methodical support.

Research and innovative work of students is an important area of training of future scientists. Between the measures of student research work an important place taken by competitions in disciplines and specialties. Olympiads provide an opportunity to identify the level of training and give impetus to creative development. Also the competitions for the best student scientific work plays an important role in this field.

The Council of young scientists and specialists is a form of self-organization of young scientists and allow them to jointly identify and solve existing problems, and to engage in dialogue with the administration of the university.

Analysis of the needs of young researchers allows us to highlight the key problems of young

researchers: the lack of moral motivation to participate in scientific work, the lack of knowledge of research methods, the problem of choosing supervisor, research topic and industrial partner, the difficulty in finding financial support for research.

To ensure the sustainability and efficiency of research work of young researchers we propose to organize competitions and to provide development grants for young researchers, to conduct trainings and conferences for young researchers, to develop an Internet portal for organizing joint execution of research by young researchers from different universities.

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REFERENCES

- [1] S. Belikov (2015) *Zvit rektora ZNTU (ZNTU Rectro's Report)*. Available: http://zntu.edu.ua/uploads/rector/zvit_rektora_2010-1015.pdf (in Ukrainian)
- [2] O Antonenko Suchasni formy roboty z obdarovanymy studentamy (Modern forms of work with talented students). Available: <http://intkonf.org/antonenko-ov-suchasni-formi-roboti-z-obdarovanymi-studentami-z-dosvidu-roboti/> (in Ukrainian)
- [3] N. Goncharuk, G. Sagdeeva (2013) *Formirovanie nauchno-issledovatel'skoj kompetencii budushhih specialistov (Formation of research competence of future professionals)*. Available: <http://cyberleninka.ru/article/n/formirovanie-nauchno-issledovatel'skoy-kompetentsii-buduschih-spetsialistov> (in Russian)
- [4] A. Nikitenko (2015) *Dosyagnennya u NDRS (Achievements in research work of students)*. Available: <http://zntu.edu.ua/projects/newspaper/uploads/2015/me-07-23092015.pdf> (in Ukrainian)
- [5] *EBEC Zaporizhzhya*. Available: <http://www.ebec.org.ua/zaporizhzhya>
- [6] *Polozhennya pro Radu MUS ZNTU (Statute of the CYSS of ZNTU)*. Available: <http://www.zntu.edu.ua/?q=node/1978> (in Ukrainian)
- [7] *Plan roboty Rady MUS ZNTU (Plan of work of CYSS ZNTU)*. Available: <http://www.zntu.edu.ua/?q=node/1976> (in Ukrainian)
- [8] *Anketa (Questionnaire)*. Available: http://www.zntu.edu.ua/uploads/dept_s&r/anketa.doc (in Ukrainian)