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Building Research Work Skills in Students as a Component of Their Professional Training

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Abstract--- The present article is dedicated to studying the importance of developing research skills in tertiary students. This problem has been raised for more than one decade and is now widely discussed worldwide. The paper reflects specifics of the classical, project-based, and comprehensive approaches in the course of building research activity skills in tertiary students. It introduces examples showing advantages and weaknesses of the existing approaches. It also summarizes scientific points of view of both foreign and domestic authors as to solving this problem, which in turn enable to comprehend the fact of the lack of universal tools for building research activity skills in tertiary students. It develops theoretical and methodological guidelines for building research activity skills in students, namely, it conceptualized a procedure for carrying out scientific research in the process of their training at tertiary institutions. This conceptualization consists of upper, lower bases, and the content. The lower basis is composed of fundamental and applied scientific research. The upper basis is represented by funding. The content includes goals, objectives and findings of students' research work (SRW).

Keywords--- Professional Training, Tertiary Institution, Students' Research Work, Conceptual Principles, Research, and Solutions.

I. Introduction

Development of research activity skills in tertiary students is due to the need to build in future specialists scientific and creative potentials a synthesis of which will make it possible to train competitive specialists for professional activity. The current labor market operation conditions impose new requirements on graduates based on the latest achievements of science and technology, which gives rise in the labor market to a demand for specialists having skills for scientific research activities, which in turn enables them to complete tasks in hand by unorthodox methods. In view of the foregoing, one of the most important tasks of tertiary institutions is to train highly qualified specialists able to seek, accumulate, reproduce new knowledge and skills, and raise their professional level.

The relevance of the problem is also due to the fact that the current approaches of Ukraine's tertiary institutions to creating a system for and improving the content, forms and methods of students' research activities as one of the important factors of training highly qualified personnel in relevant fields are characterized by certain features requiring study and generalization.

Reviewing scientific publications allowed concluding that combining the educational process with scientific research activities implies building in students such skills as logical thinking, search for necessary information, innovative methods for its analyzing and processing, modeling of problem situations and forecasting of their consequences. In addition, it was found that contemporary science already has in its arsenal preliminary studies and advances in the area of building research activity skills. Thus, for example, in the paper by Clark, A. Changing classroom practice to include the Project approach. Early Childhood Research & Practice, the author raises issues of developing critical thinking at an early age arguing that it is advisable to use the project-based approach as such a tool (Clark 2006).

Preschool education on the ground of the project-based approach is also covered by works of other authors such as Mitchell, S., Foulger, T. S., Wetzel, K. (Mitchell, 2009). In their studies, scholars place the emphasis on the positive aspects of this approach noting that such a vision contributes to shaping step-by-step education from an early age without separation from the realities of the contemporary labor market.

The project-based approach is very extensively used in engineering. Some of the proponents of the project-based approach to training under an engineering program include Uziak, J. (Uziak 2016), Serikov, V., Pichugina, V., & Saurenko (Serikov 2015), N. Machado-Toledo, J., Mora, C. E. (Machado-Toledo 2018), Springer, Cham., Jalinus, N. (Jalinus 2017), Chen, C. H., & Yang, Y. C. (Chen 2019) and others.

The authors of this study share the view of other scholars but we believe that using only the project-based approach does not adequately facilitates building students' research activity skills in the course of their training at tertiary institutions, since the higher education system is intent on achieving not only such goal as development but also those of training and education, which in turn implies the comprehensive approach. The story of Sam Pickering who taught at Montgomery Bell Academy represents a shining example thereof confirming this point. His good intentions encouraged students to freethinking and caused their excessive divorce from educational standards, which in turn gave rise to their elitist perceptions and beliefs and distorted their view of their peers.

The need for consistency of educational standards and teaching tools is also highlighted in the paper by Mitchell, S., Foulger, T. S., Wetzel, K., & Rathkey, C. (2009). The paper's authors note that the maximum effect in teaching can be achieved by combining standard and nonstandard teaching methods. Such a (comprehensive) approach enables to obtain a result at the level of both the teacher and the learner.

It was also found that there are a number of authors who harshly criticized the ideas of project-based learning (G. Spiders, E. Spranger, L. Gurlitt, F. Ouri, A. Vazquez, and G. Delledale et al.). According to the opponents, such an approach devalues the role of the teacher in the education system. The author of this study approves this stand believing that lack of a "tutor" (teacher) will adversely affect the quality of knowledge.

Consequently, we concluded that by this day there are splits over the most effective tools for building research activity skills in students in the process of their training at tertiary institutions, and therefore the chosen line of research can rightly be considered as topical and requiring additional systematic studies.

The purpose of the article is to develop theoretical and methodological guidelines for building students' research activity skills in the process of their training at tertiary institutions.

Based on this purpose, the following tasks were set and completed:

1. To systematize the scientific approaches as to solving problems associated with building students' research activity skills in the process of their training at tertiary institutions.
2. To conceptualize a procedure for carrying out students' scientific research in the process of their training at tertiary institutions.

The research material we submit for consideration is of the second degree of novelty, the essence of which consists in conceptualizing a procedure for carrying out students' scientific research in the process of their training at tertiary institutions.

II. Methodology

The methodological background of the study is primarily composed of a set of scientific knowledge methods and general scientific and special research methods. Thus, in order to form the author's vision of the category of students' scientific research work at tertiary institutions, methods of empirical and theoretical knowledge were employed.

Fundamental tenets in such areas as pedagogy, psychology, and higher education served as a theoretical basis. In particular, works by the founders of the project-based approach J. Dewey, W. Kilpatrick, Hein Retter, J.F. Callahan, Clark Leonard Hull (Ann-Marie Clark were examined (Callahan 1983; Dewey 1996; Clark 2006). The above-mentioned authors reject the classical lesson system assuming that it is imperfect and focused only on "thoughtless learning of stereotyped intellectual actions."

We carefully examined studies by followers of the classical school of pedagogy who state that "project activities themselves are not some kind of innovation in pedagogical theory and practice and are designed to destroy rather than create."

The empirical aspect of building students' research activity skills in the process of their training at tertiary institutions includes the author's personal experience and observations.

III. Findings and Discussion

In the present context of society development, the fact that society forms and exists in the knowledge-based economy environment is becoming obvious. New knowledge is acquired in the course of transformation of information. Therefore, it is advisable to consider raising the educational level of the population against the information society formation processes occurring based on information technology. (Martynovych, 2019).

Ukraine is one of the top twenty world's countries with the highest enrolment ratio in higher education. However, the chasm between knowledge and skills offered by educational establishments and requirements of employers is increasingly deeper. (Bakhov 2014, Bakhov, Boichenko, 2019).

It was found in the course of systematizing the problems of students' research work organization at tertiary institutions that tertiary students' scientific activities should be regarded as two interdependent and interrelated components – educational research and scientific research ones. Research work is the initial stage of students' scientific activities aimed at developing research skills and abilities, which show in the search for an explanation of certain regularities, facts, phenomena, and processes dominated by independent application of scientific methods of cognition.

In this paper, research work means independent creative research into a certain problem.

As previously noted, research activities are one of the progressive forms of science development carried out as part of scientific activities for the purpose of comprehensive study of an object, process or phenomenon, their structure and relations, as well as achievement and introduction of scientific results into practice.

The highest level of education provides for students' gaining in-depth theoretical and practical knowledge, abilities, and skills in a chosen trade, a general framework for methodology of scientific and professional activities, and other competencies sufficient for effective performance of tasks of an appropriate level of professional activities. Building these competencies is possible as part of students' research activities for the purpose of comprehensive study of an object, process or phenomenon, their structure and relations, as well as achievement and introduction of scientific results into practice.

Furthermore, contemporary theory of scientific research activity at tertiary institutions provides for various forms of its performance, which necessitates its systematization. Considering the above, the authors of this paper suggest their own vision of a procedure for conducting students' scientific research in the process of their training at tertiary institutions (Fig. 1).

Conceptualization of a procedure for conducting scientific research at tertiary institutions is based on the comprehensive approach since it is the one, which, in the author's opinion, will enable to avoid controversial disputes, as in the case with the followers of the project-based and classical approaches, through the use of various tools with a focus on the final result. Moreover, the chosen approach helps harmonize the interests of students, tertiary institutions and labor market representatives, which in turn ensures obtaining trilateral benefits. Accordingly, the suggested solution is universal and can be applied not only at various tertiary institutions and in different regions but also in diverse countries regardless of mental, moral, cultural and other distinctions.

Thus, it is expedient to consider students' research work as exploratory activities of a scientific nature as a result of which subjective cognition of the reality acquires a certain objective theoretical and practical significance and novelty.

As experience and scientific generalizations show, the students' research work system at tertiary institutions should operate along naturally related lines: research work in the educational process and in cognitive activity. In its turn, the concept of students' research work includes three interrelated elements:

1. Teaching students in research activity elements; scientific creative activity organization and techniques.
2. Scientific research carried out by students under the supervision of professors and instructors.
3. Students' research work as an element of educational activities associated with science and technology achievements extension.

So, basic and applied scientific research forms the basis for research activities, the so-called lower basis. Basic scientific research is represented by theoretical and (or) experimental activities designed to gain new knowledge on regularities of functioning, development and interrelation of nature, society, and man. Applied scientific research is represented by activities mainly aimed at employing new knowledge in order to accomplish practical purposes and solve specific practical tasks. It can be said in other words that it aims to solve problems of using scientific knowledge obtained owing to basic research in practical activities of people.

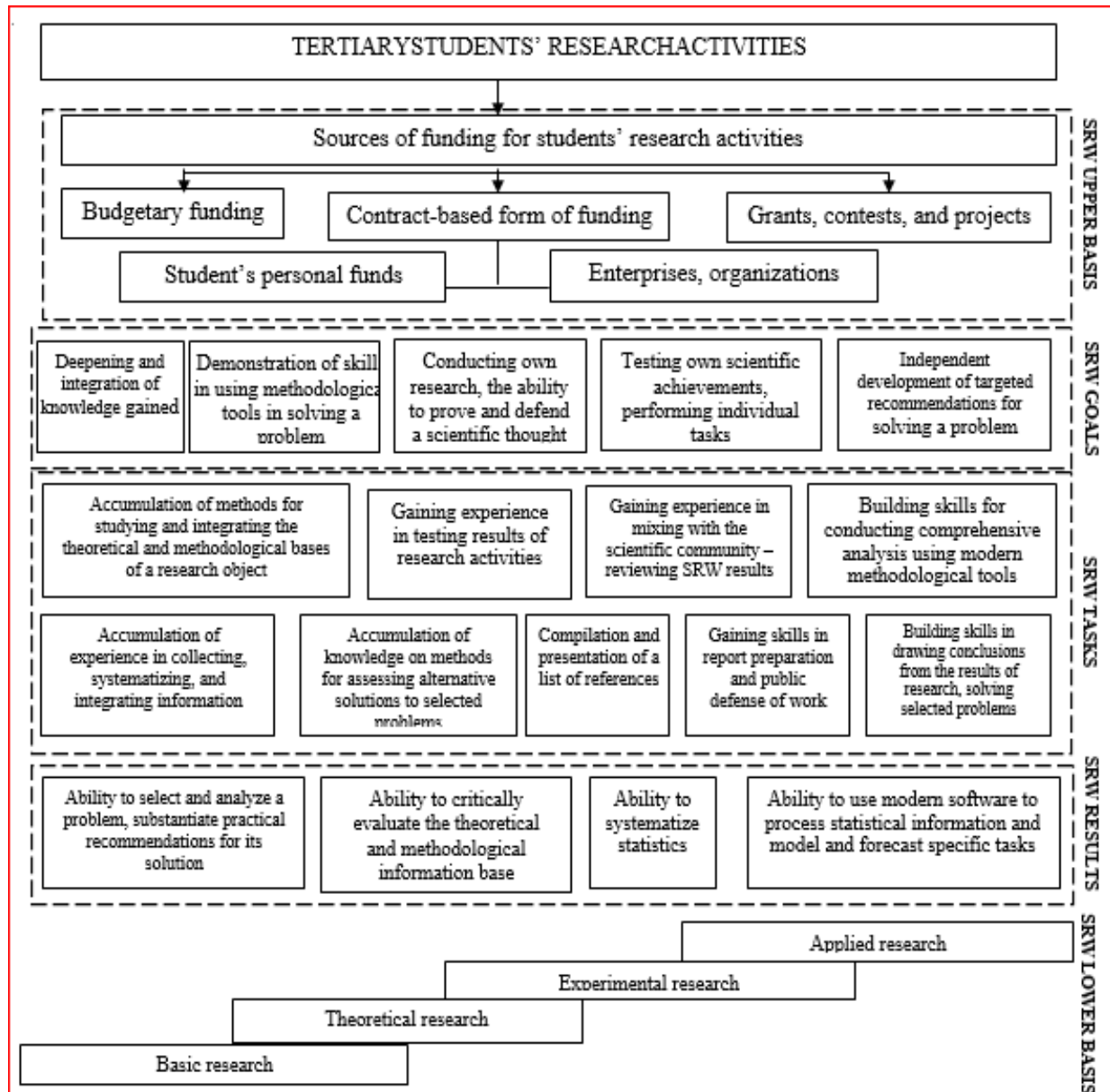


Fig. 1: Conceptualization of a Procedure for Carrying out Research in the Process of Training at Tertiary Institutions

If the lower basis of students' research activity is formed by its various kinds, the upper basis is represented by funding. This is due to the fact that any science project is associated with costs for its implementation. Sources of funding for research activities in this case are divided into budgetary ones financed out of public funds, contract-based ones financed by client organizations based on contracts and those not financed but existing on the initiative of a researcher (student), for example, due to a registration fee for participation in a conference or a publication in a dedicated journal on the subject of the graduation qualification thesis. In addition, current scientific studies are often financed using raised grant funds. This is a relatively new form of financing scientific studies in Ukraine, which accounts for only 0.1% of internal costs for research and development among the funding sources in terms of the country criterion and only 7.3% (in 2017) for the higher education sector.

The structure of internal costs for research and development by funding sources/countries and by science sectors/countries for 2017*(%) is more clearly showed in Fig. 2-3. Compiled by the author according to figures from Statistical compendium "Scientific and Innovative Activities of Ukraine in 2018". Based on the above figure, one can conclude that Ukraine allocates mainly budgetary funds for research and development, which amounted to 37.1% as of December 2018. A similar trend is observed in East Asian countries – China (76.1%), Republic of

Korea (75.4%), Taiwan (77.7%), and Japan (78%) [Science. Technology]. In European countries, the trend is different; the largest share of funding comes from the business sector, which indicates that not only the state but also business is interested in research activities. Accordingly, it holds an interest in specialists.

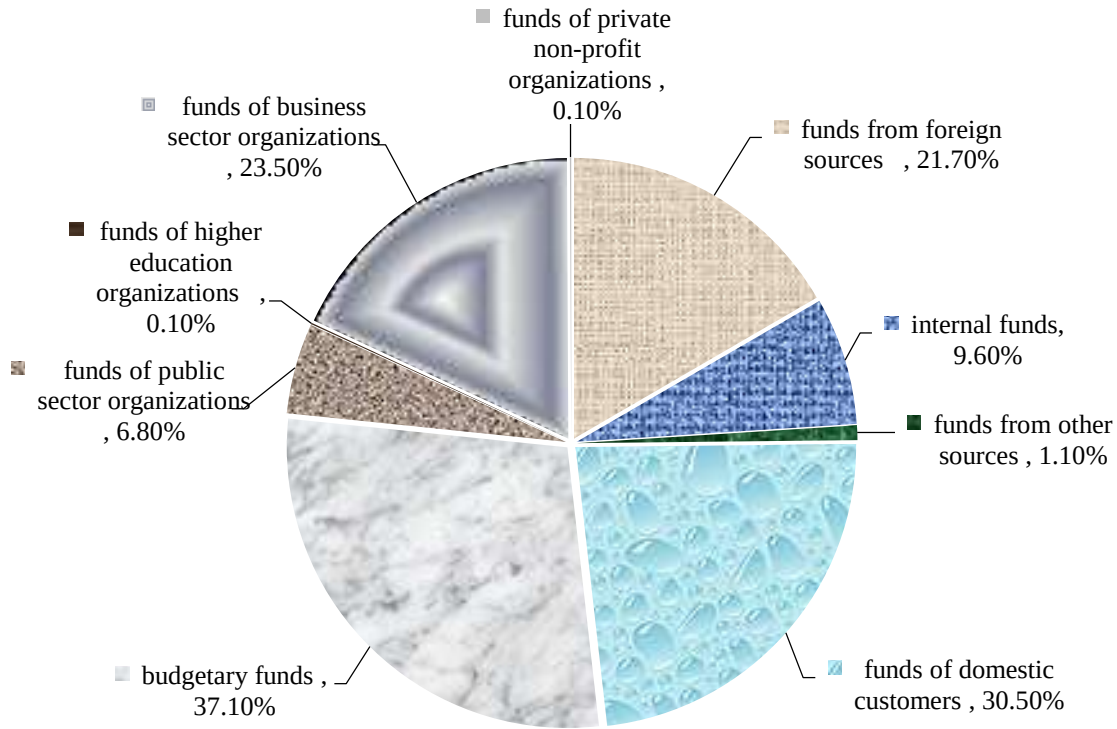


Fig. 2: Distribution of Financing Internal Costs for Research Work by Funding Sources in 2018, (%)

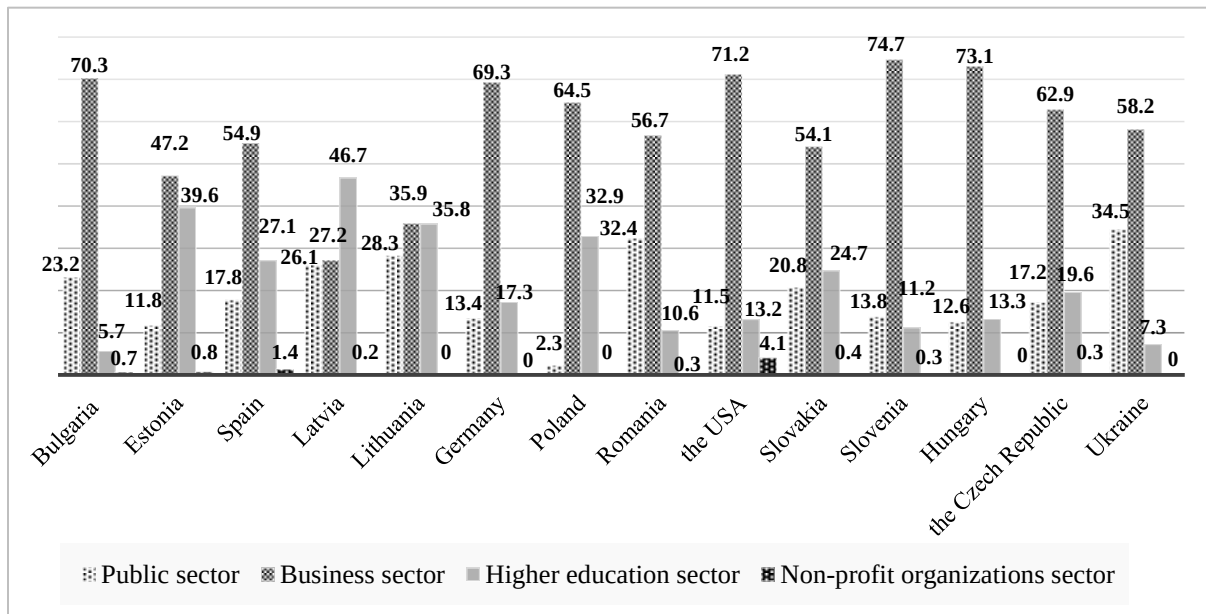


Fig. 3: Structure of Internal Costs for Research and Development by Science Sectors and Countries: 2017 (%).
Compiled by the Author According to Figures from Statistical Compendium

The figures show that in Ukraine research and development in education have the least value in 2017 -- 7.3%, which is the lowest rate after Bulgaria (5.7%), while this indicator is 39.6% in Estonia, 27.1% in Spain, 46.7% in Latvia, 35.8% in Lithuania, and 32.9% in Poland, which is on average five times more than in Ukraine. Such a trend has a negative impact on the results of students' research activities as a whole, since the main motivator, material reward, is missing.

Conceptualization of a procedure for conducting research also contains a unit of goals, objectives, and findings of students' research activities. These structural elements were formed based on an analysis of works by such authors as A. V. Kiryakova, T. A. Olkhovaya, and I. D. Belonovskaya. In particular, solutions concerning a new direction in building the teaching and educational process based on the value-oriented approach were taken into account. (Kiryakova, A. V. et al.)

Formation of the unit of students' research work findings is based on the research work methods developed by such authors as O. Yu. Malinova and Ye. Yu. Meleshkina (Malinova, O. Yu., Meleshkina, Ye. Yu.)

Implementation of research activities by actors of the educational process at universities contains four interrelated concepts, which facilitate it: methodological (which provides insight into interaction of general scientific and specifically scientific methods prior to distinguishing components of research activities), historical (which provides for a historical retrospective of the development of research activities performed by actors of the educational process at universities), theoretical (which determines distinguishing regularities, approaches, and principles of implementing the concept of research activities performed by actors of the educational process at universities), and practical (which provides for practical implementation of research activities in the educational environment of universities). (Concept and methodology)

Also, the SR W findings unit reflects the conceptual tenets by S. G. Vershlovskiy (Vershlovskiy 2010), namely, his idea of forecasting in the education sector. Since it is just forecasting, in the author's opinion that "stimulates initiative, creativity, innovations on the part of the participants in educational activities, which in turn helps overcome the usual, established -- all that hinders the progressive development of education."

This study specifies the conceptual principles for implementation of research activities by the actors involved in the educational process at universities as follows:

- Substantiation of the fundamental principles of reforming the system of scientific and research activities of the actors involved in the educational process at universities;
- Introduction of European experience in training of the actors of the educational process at universities for scientific and research activities;
- Formation of a scientific inquiry methodology;
- Intensification of building scientific and research competencies;
- Organization of methodological, didactics up port for building scientific and research competencies of those receiving higher education;
- Mastering technologies of self-education and self-training; and
- Ensuring integration of science and practical educational activities.

Implementation of the conceptual principles provides for using research methods through which pedagogical science obtains new information on various phenomena and processes, analyzes and implements research findings directly into the educational process. The diversity of teaching activities-- according to S. Honcharenko -- determines a wide range of research methods that can be classified by various principles (criteria) -- purpose, degree of insight into the essence of an object of study, and scientific nature (Honcharenko 2012).

Thus, the following *goals of students' research activities* were set:

- Deepening and integration of specialty knowledge gained;
- Demonstration of skills in using methodological tools in solving a selected problem;
- Conducting own research;
- Ability to argue and defend own scientific thought;
- Testing own scientific achievements;
- Gaining independent work experience when performing individual tasks; and
- Development of targeted recommendations for solving a selected problem.

The unit of students' research activity tasks is as following:

Students' research activities ensure completion of the following tasks:

- Accumulation of methods for studying and integrating the theoretical and methodological basis of a research object;
- Formation of a scientific worldview, mastering research methodology and techniques;
- Building abilities for independent research and practical activities; accumulation of experience in collecting, systematizing and integrating socioeconomic information;
- Development of students' creative thinking and individual abilities in completing practical tasks;
- Building skills in carrying out comprehensive analysis of a situation using state-of-the-art methodological tools;
- Broadening the theoretical outlook and scientific erudition of future specialists;
- Accumulation of knowledge on methods for assessing alternative solutions to selected problems;
- Shaping perceptions of calculations of the effectiveness of suggested recommendations for solving selected problems;
- Building skills in drawing conclusions based on research findings;
- Compilation and presentation of a list of references;
- Gaining experience in testing results of research activities;
- Gaining skills in preparing a report for public defense of work;
- Gaining practical skills in presenting display material, conveying the main content and results of work, the Author's proposals;
- Gaining experience in mixing with the scientific community – obtaining reviews of research work results; and
- Gaining skills in public defense of research findings before the scientific community, at conferences, "roundtables" etc.

Based on the goals and objectives of the procedure for carrying out tertiary students' research, a unit of SRW findings was formed, the essence of which is to build in students abilities to select and analyze a problem; assess changes occurring at the present stage of the county's socioeconomic development; apply acquired knowledge when solving specific problems; substantiate practical recommendations for their solution; critically evaluate regulatory legal acts and literary sources; use up-to-date research methods; systematize statistics; use modern software to process statistical information, and model and forecast specific tasks.

Students' research work as part of the educational process is compulsory for each student and covers almost all forms of academic work:

- Writings say son a specific topic in the process of studying disciplines belonging to social sciences and humanities, professionally oriented and special disciplines, and elective courses;
- Fulfillment of laboratory, practical, seminar, and independent assignments, tests containing elements of problem is tic search;
- Fulfillment of a typical research – based assignments during the practice period;
- Development of guidance materials using research methods (glossaries, programs of and techniques for sociological and psycho-pedagogical research etc.); and
- Preparation and defense often papers and graduation theses related to the problems of scientific research of relevant departments.

Research work is carried out over a particular period of time. It can be performed with in one discipline during the period of its study. It can also be carried out under a state-financed and contractual topic of a relevant department.

A scientific supervisor for conducting research activities is selected by a student or appointed by the head of a relevant department.

The *duties of the director* of the student's research work should include the following consulting assistance:

- Development of a time schedule for carrying out research;
- He/she recommends monographic and teaching-method literature, reference materials, original papers in special scientific periodicals, normative and reference materials, standard projects and other literary sources on the chosen research topic;
- Holds consultations on issues of drawing a research work plan; and
- Advises the student on issues the student faces in the course of carrying out research activities.

In order for the student to succeed in research activities, he/she must be assisted in its proper planning, organization, and conduct. And, first of all, it is necessary to develop an action plan. The entire process of conducting student research can be conditionally divided into the following units:

- *First* – stage of information search and problem analysis;
- *Second* – stage of conducting research;
- *Third* – consolidation of research work results.

It is important to emphasize that the research plan and sequence of work performed depend on the object, goals and kind of research.

To achieve success in scientific research, it must be properly planned, organized, and carried out in a certain sequence:

1. Stage. Choice of the topic of research work and the object of study.
2. Stage. Formation of a timetable for implementation of research work.
3. Stage. Selection and processing of literary sources related to the chosen research topic.
4. Stage. Drawing up a work (content) plan.
5. Stage. Collection of statistical information necessary to perform research work.
6. Stage. Analysis of statistical information, which can consist in the following:
 - Systematization of information;
 - Analysis, synthesis and evaluation of information; and
 - Description of the obtained time series.
7. Stage. Study of the identified problems, their description.
8. Stage. Formulation of conclusions based on the research findings (Main requirements 2007).

It should be noted that students' research work is carried out in order to obtain a scientific and practical result. A scientific result of students' research activities should be understood as acquisition of new knowledge (an increase in new knowledge), new structural or technological solution, and experimental sample obtained in the course of scientific research and formalized in the form of a scientific report, scientific work, research report, and scientific information on research activities.

IV. Conclusions

Consolidation and summarization of scientific points of view made it possible to establish that to date there is no universal toolkit for building research activity skills in tertiary students. Given this, it was decided to systematize the existing scientific approaches and conceptualize a procedure for conducting students' scientific research in the process of their training at tertiary institutions.

The systematization process enabled to conclude that research work of tertiary students should be understood as independent creative study of a particular problem based on two interdependent and interrelated components -- educational research and scientific research ones. The advisability of using a comprehensive approach in the process of building research activity skills in tertiary students was substantiated.

An authorial procedure for conducting students' research at tertiary institutions is suggested as being universal and able to be applied not only by various tertiary institutions and regions, but also in various countries, despite mental, moral, cultural, and other differences.

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