THE METHOD DEVELOPMENT TO COORDINATE STUDENT SCIENTIFIC RESEARCH WHILE PURSUING A BACHELOR'S AND A MASTER'S DEGREE

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Abstract

At present, scientific research practices is one of the most important components for graduate training at university, and is also one of the constituents of the whole training process. Therefore, learning activities should be arranged so that students could have not only proficiencies in their major, but also move forward with independent search for new skills, perfect research methods, learn about nonroutine techniques of solving scientific problems, learn to analyze various data flows. The problem concerns the fact that most students are not active enough to be involved in such kind of activities. In this case an educator's role is to motivate students by organizing scientific research with them. The aim of the research is to develop and test the methodology for managing and structuring of student scientific research while pursuing a bachelor's and a master's degree. The pedagogical experiment was conducted from 2014 to 2018 and took place at Sholom-Aleichem Priamursky State University, Siberian Federal University, Krasnoyarsk State Agrarian University, Far East Institute of Management (Branch of RANEPA), Omsk State Technical University, Moscow State University of Civil Engineering, Blagoveshchensk State Pedagogical University, and Pacific National University. 162 students and 45 lecturers participated in it. The authors developed such components as the online course *The Basic Scientific Research*; the method of involving students in scientific research; practical topics to put into the full course content; the online course on teaching lecturers to the methodology offered. In the course *The Basic Scientific Research* learners are taught to the issues of scientific knowledge methodology, a choice of a trend and stages of scientific research, methods of scientific research and registration of scientific results, writing an application style for a grant. Students complete a not complicated research project; publish the results in an article for a proper journal guided by an instructor. The lecturers of subject oriented department attracted students to scientific research through the organization of research projects in their majors, the presentation of their results at various conferences, in scientific journals and the encouragement by adding number of points in a student rating system. Within the course methodology, lecturers included topics in preparing the review of scientific articles on current field-oriented research, the databases Scopus, ScienceDirect, Web of Science, eLibrary operation, reviewing

scientific papers. The authors used the original questionnaire to clarify student attitude toward scientific research practices. According to the survey, it was found out that completion curriculum interests of students were focused more on scientific research in their future career. The proposed organization methods made it possible for students to publish more than 400 scholarly articles and win 19 grants to carry out research of various levels. One-third of the participants in the experiment used to get a notable semester scholarship for scientific research regularly. They took part and won competitions for the President of the Russian Federation grants and the Government of the RF. The completed research projects were applied to various contests to compete and won prize-places. The methodology that has been developed for arranging scientific research with students can be scaled and used at universities.

Keywords: active learning, research-based learning, student scientific research, theoretical scientific research, research project.

1. INTRODUCTION

Present-day society needs initiative and independent experts who are motivated to improve constantly their professional competences required by industry. Such professionals are characterized by high sensitivity, curiosity, willingness to upgrade their know-how quickly and a wide range of skills. As Breen et al. emphasize, “The emerging knowledge economy is one that requires individuals with creativity and ability to develop, find and synthesize new knowledge” (Breen, 2003). The main goal of higher education is to develop a learning content that ensures graduates’ relevance and competitiveness in the labor market (Ruchina, Kuimova, Polyushko, Sentsov and Jin, 2015).

These days, scientific research is an essential component for training specialists capable of developing and applying industry technologies 4.0. That is why, it is better to arrange education for students to get not only proficiency in their major, but also promote independent search for new knowledge, practise research methods, learn more about innovative techniques of solving scientific issues, know how to analyze various information flows. The problem is that students are not quite eager to be engaged in such activities (Babamohamadi). They feel fear of difficult challenges (Denham, 1996; Edwards and Thatcher, 2004). In this case, an educator is to organize scientific research with students properly (Kozlova and Atamanova, 2013).

All students in higher education should be taught through carrying out research.

The aim of the research is to develop and test the methodology for managing and structuring of student scientific research while pursuing a bachelor’s and a master’s degree.

2. METHODOLOGY

2.1. Literature Review

Many teachers are aware of the necessity to develop student research abilities.

In O.V. Akulenko’s opinion, properly organized and planned student scientific research while studying at university, performs serves as the following:

- Instructional function: mastering theoretical (scientific facts) and applied (scientific research methods, methods of carrying out surveys, ways of applying science) knowledge;

- Structuring-based function, i.e. be able to be experienced in literature and other reference resources; develop skills to organize and plan their activities; choose methods of information processing;

- Analytical and correction function: a student reflection, one’s self-evaluation, self-actualization of planning and arranging one’s own activities; correction and self-correction of educational and cognitive activity;

- Conative function, i.e. to cause and strengthen interest in science while carrying out scientific research, cognitive needs, belief in theoretical and practical significance of scientific knowledge being developed; to inspire a wish to get deeper acquainted with the issues of the field of scientific knowledge under study, a variety of points of view; encouraging self-education and self-development;

- Stimulating function, i.e. to develop critical, creative thinking, the ability to act in standard and non-standard situations, the ability to explain, assert one's point of view; understand upgrading of motivation (interest, aiming at learning), mastering skills (cognitive, communicative, special abilities, etc.);

- Educational function, i.e. realizing ethic and legal identity; education of the ability to adapt to a changing social environment; developing adequate self-acceptance, responsibility, personal leadership, determined self-direction, courage in overcoming difficulties and other abilities, and character traits. The upbringing function also includes education of professional vocation and professional ethics (Akulenko, 2005).

S.L. Danilchenko points out the following current approaches to teaching scientific research of university youth:

- Organizational and activity approach, implemented by involving students in scientific research starts since the first year of university study. Of course, tasks facing freshmen and undergraduates are different;

- Systemic functional approach means student mastering the methodology and strategy of scientific research, enhancing competence in this or that field, as well as further development of scientific and cognitive interests. There have been posed research and training tasks to involve students in scientific activity. They are a selection of scientific literature on a certain topic, compiling an annotation of particular original sources, their abstracting, comparing different points of view, approaches to the same problem, generalization, systematization of knowledge from different sources, tabling, charting, diagramming, modeling, etc., identifying ways of using the problem approach in teaching and steps to solve a problem situation in learning, i.e. preparation of a problem situation, problem definition, hypothesizing, etc .;

- The use of a heuristic approach in training research skills in the course of student independent work at seminars, laboratory and practical classes. Lecture course should include information on the findings of scientific research in recent years, while providing an atmosphere of creative discussion of scientific issues in various fields of science;

- Applying the personality-activity approach. In all types of classes, students should be asked to perform research problems that require a thorough analysis of knowledge students get at lectures, seminars, practical and lab classes, but also when doing independent work with the basic and supplementary books. This kind of tasks should be already planned in the first year and complicated gradually in each individual case when mastering special subjects. In the third year while preparing for completing a graduate thesis, students support evidence-based investigation on their own, emphasize an object and a subject, suggest a current hypothesis, define the purpose and tasks of the study, map out a course of action, determine the methodological system. Then students study scientific literature, collect empirical data, process them, draw conclusions and make summaries (Danilchenko, 2005).

It is also possible to use pedagogical methods in teaching scientific research. They are discovery learning (Anthony, 1973); problem-based learning (Barrows and Tamblyn, 1980; McBurney,1995; Davis, Wagner, Gleim, Andolsek, Arheden, Austin, Courtney-Eighmy, Gradison, Leist, Maynard, Noga Jr, Ostbye and Eisenstein, 2006), inquiry learning (Papert, 1980; Rutherford, 1964; Healy, Jenkins, 2009), experiential learning (Boud, Keogh and Walker, 1985), and constructivist learning (Jonassen, 1991; Steffe and Gale, 1995).

At present, many scientists are engaged in developing effective methods for teaching scientific research to students of various majors. I.B. Kamenskaya and A.I. Kamenskiy reported on organizing scientific research of philology students (Kamenskaya and Kamenskiy, 2014). E.Vorobyeva and P. Ermakov focused on teaching research methods to psychology students (Vorobyeva and Ermakov, 2015). S. Winn commented on the difficulties of involving students in sociological research (Winn, 1995). S. Court and M. Molesworth were engaged in teaching scientific research to students-marketing experts (Court and Molesworth, 2003). P.M. Poindexter proposed a model for effective teaching research methods for journalism students (Poindexter, 1997). J. Fenwick observed the issues of teaching research methods to students of public policy (Fenwick, 1992). R. Monson reviewed training through a research project (Monson, 2017). W. E. Lovekamp et al. suggested using a questionnaire at the beginning of the study to help understand the content (Lovekamp, Soboroff, and Gillespie, 2017). R.K. Schutt, et al. outlined the objectives of the courses on research methods (Schutt, 1994). N. Martyushev et al. considered the main trends in intensification of student scientific research, young scholars and lecturers, listed the main types of student scientific research, suggested recommendations that would motivate students to perform scientific research (Martyushev, Sinogina and Sheremetyeva, 2015). L. Brennan, et al. highlighted the themes that contribute to developing a student as a researcher (Brennan, Cusack, Delahunt, Kuznesof, and Donnelly, 2017) M.B. Hesse and C. Schubert presented the content and methodology of designing a semester course research project (Hesse and

Schubert, 2017). M. Garner et al. showed how it is possible to encourage and provide a high quality of teaching research methods (Garner, Wagner and Kawulich, 2009).

2.2. Study Design

To achieve the goal of the research, it was proposed to develop an online course *The Basic Scientific Research*, a methodology for involving students in research, specialized topics of vocational subjects, and an online course for teacher training the technology proposed.

The pedagogical experiment was conducted from 2014 to 2018 and took place at Sholom-Aleichem Priamursky State University, Siberian Federal University, Krasnoyarsk State Agrarian University, Far East Institute of Management (Branch of RANEPA), Omsk State Technical University, Moscow State University of Civil Engineering, Blagoveshchensk State Pedagogical University, and Pacific National University.

162 students of IT and economics majors including 121 undergraduate students, 31 undergraduates took part in it. The distribution of the years among the undergraduate students is the following (the year since which the methodology started): 1st year- 16, 2nd year- 23, 3rd year- 58, 4th year- 34 learners.

45 teachers were taught the course on teaching the methodology suggested.

3. RESULTS

3.1. Online Course the Basic Scientific Research

The course *The Basic Scientific Research* allows you to acquire knowledge on the basic theoretical foundations, technologies, practical methods and ways of conducting scientific research based on scientists' new achievements, as well as master the skills of choosing a topic of scientific research, scientific search, analysis, data processing, getting effective solutions using information technology.

The purpose of the developed subject is to master concepts of principles, terminology, and content, a particular organization and management of scientific research by students.

The objectives of the subject are discovering the substance of scientific research, trends and its results; introducing the basic theoretical positions, technologies, practical methods and ways of scientific research; studying planning and organization methods of scientific research; studying the principle of scientific search, analysis, carrying out surveys, etc.; learning the choice of a topic for scientific research; studying the basic methods of scientific research; reviewing the ways of searching for information on scientific research; studying a form filling applications for grants.

The course *The Basic Scientific Research* includes lectures, practical classes and self-education exercises, evaluative supplies and test tasks. The course lasts for 72 hours (2 credit units). It is published in the information-educational environment of Sholom-Aleichem Priamursky State University at http://moodle.pgusa.ru/course/view.php?id=5253

The course contains eighteen lectures, three practical classes and nine self-education assignments. The authors described all classes in students' major to be prepared to participate in scientific research. They also made a schedule according to the following structure: a title; an aim; the main part; test questions (for lectures); applied findings (for practical lessons).

The objectives of the work are set according to the outcome to be expected in one's investigation.

The lectures contain information on the basic concepts of scientific research, a style of writing articles and structures to describe it, a way of choosing a topic for scientific research, information search systems, a manner of organizing work with scientific literature, a correct analysis of existing development on the chosen theme, a way to write and place a reference list, a way of working with Elibrary, Web of Science and Scopus, appropriate goals for participating in grants and writing an application. The authors made up test questions for each lecture. First, they are prepared to examine the lecture, and second, for a student to realize the contents correctly.

Students can apply their knowledge in practical classes from lectures, namely work with databases (Elibrary, Web of Science, Scopus), put a bibliographic list, choose a topic for scientific research, write an abstract for an article, a review of research, write an article, design and publish articles, prepare an application for a grant. Practical classes are developed with detailed plans and examples.

Self-education is the most important condition for thinking development, self-consistency and cognitive

activity. They are aimed at teaching a student the basics of scientific research, describing the research correctly, speaking one's own mind freely, putting the results according to certain criteria, and present them. In the course *The Basic Scientific Research* there are nine topics designed to be learnt in 36 hours (1 credit unit). Each task for self-education activity is made up according to the structure and consists of a theme; an aim; a description; instructions; requirements for paper formalities (a report, an article, etc.); themes for research projects. It is necessary to complete a small project during the course and prepare the results in a scientific paper.

A final grade (credit) for the subject is given if there are enough points in the rating system based on the results of the control when studying the contents. To pass a credit a student has to perform practical and self-education work, present the results of his/her own research project.

3.2. The Methodology of Involving Students in Scientific Research

Kirschner et al. determined that the least guidance by student scientific research during their training does not make any sense. In order to achieve a proper result, the author insists on using some complex methods (Kirschner, Sweller, and Clark, 2006), developing creative initiative (Luchaninov, Bazhenov and Bazhenova, 2017). The scholars believe that it is necessary to have a system involving students in scientific research.

The idea is that lecturers of the related department are to reconstruct the contents of their subjects on purpose, teaching methods and to motivate, encourage participating in scientific research.

Thus, students are in the environment where successful learning is impossible without active scientific research throughout the whole studying.

The methodology of involving students in scientific research consists of several points below:

1. There are classes introduced in the contents of the vocational course to prepare an overview of current scientific research.

2. It is necessary to implement and have an educational research project. It is required to write a scientific article according to the results of it and present them at conferences of various levels. Themes of the project should be defined in agreement with the content of the subject taught. The level of complexity should correspond to the training course.

3. A lecturer is interested in carrying out joint research with a student and cooperates with him/her.

4. Themes of course papers are scientifically notable and new, the results are published in journals and in conference proceedings.

5. A large number of points in the rating system to assess the activities for a subject are given for a research project. Moreover, a lecturer can give a student a credit or an exam pass.

6. The staff of the related department settles it among themselves; they get together and guide groups of those students who are interested in it. They actually tutor them, help to map a schedule for scientific research in a term, inform on upcoming competitions, conferences, and provide methodological assistance in writing articles.

7. Those projects that are well done are going to take part in various competitions, funds to support scientific research. Lecturers give students a hand in preparing documents.

8. Students are informed about the possibility of participating in the competition for a semester-long merit-based scholarship for scientific research. A lecturer helps in preparing documents and works with some suitable applicants on purpose.

9. A lecturer involves students in performing their grant scientific research.

10. Lecturers of the related department use their contacts and provide graduates opportunities for employment. This type of activity is necessarily performed by students today.

3.3. Topics for Including in the Content of the Subject

It is necessary to include the following topics in the content of the subject for students to be involved in scientific research successfully:

1. Current scientific research review on the subject.

2. Textbook and teaching aids review on the subject.

3. Making a review of the author's synopsis of a thesis.

4. Making a book review.

5. Carrying out the research project.

The authors would like to explain the principles of teaching the proposed topics.

It is required to set the stated task in order to perform an overview of current scientific research. The task includes the following points:

- Topics of the subject prospects. The prospects wordings can be taken from the actual scientific conference. Wording in English is an essential prerequisite. A student is to choose one and should consult a teacher about what the topic includes.

- Choosing at least 10 English scientific articles. The authors suggest using Scopus, Web of Science, ScienceDirect, Google Scholar resources for search. The result should be supplied in a pattern: references in APA style; URL, the title in Russian; abstract in English; abstract in Russian;

- Choosing at least 10 Russian scientific articles. The authors suggest using eLibrary, Google Scholar resources. The research should be supplied in a pattern: references according to the National standard GOST R 7.0.5-2008 - Bibliographic reference; URL, abstract in Russian;

- Choosing at least 5 original monographs in English. The authors suggest using Springer, Google Scholar resources. The research should be supplied in a pattern: references in APA style; URL, the title in Russian; abstract in English; abstract in Russian;

- Choosing at least 5 original monographs in Russian. The authors suggest using eLibrary resources, Google Scholar. The research should be supplied in a pattern: references according to the National standard GOST R 7.0.5-2008 - Bibliographic reference; URL abstract in Russian;

- Choosing at least 5 original Russian theses research. The authors suggest using eLibrary, Google Scholar, diss.rsl.ru. The research should be supplied by references according to the National standard GOST R 7.0.5-2008 - Bibliographic reference; URL, abstract in Russian.

For textbook and teaching aids review on the subject, a student has to select 5 Russian-speaking and 5 English-language publications. He is recommended to use of eLibrary, Google Scholar, an electronic library system of the university. The result is performed as in the previous task.

A student can use the sources that he/she had already found to complete the task of making reviews on the author's summary of the thesis research and a book. Page size of the review is 1 sheet of A4.

A lecturer can offer the themes of the educational research project or use students' ideas. It is important to a lecturer to assess the complexity of the project correctly and a student ability to cope with it. Thus it is necessary to note the participant's capabilities. The tasks of the project should be definite and particular. If the project is complex, one can divide students into groups, but then each participant has to be aware of his/her part exactly.

3.4. Online Course on Training Teachers the Methodology Offered

It is necessary for teachers to know the methodology well to be able to use it perfectly. They have to understand how to carry out research, publish their research findings, involve students in the scientific field, understand what difficulties are there (Edwards and Thatcher, 2004; Garner, Wagner, and Kawulich, 2009).

The authors having used their own solutions and good practice (Martyushev, Sinogina and Sheremetyeva, 2015; Garner, Wagner and Kawulich, 2009), designed the online course. They put it on http://moodle.pgusa.ru/course/view.php?id=7.

It has the following topics: teacher ratings; the teacher rating and the student scientific research; a technology of writing a scientific article with a student; a scientific event arrangement; software registration in the Russian Federal Service for Intellectual Property, commonly known as Rospatent; web publishing in journals covered by Scopus, Web of Science database; ways to look for Russian and foreign like-minded colleagues to invite them to one's scientific fruitful communication; a technology to mobilize external finance for research.

There are webinars and video recording on all topics in the course. There are tests and applied assignments to check knowledge.

At the end of the course lecturers (learners) received a certificate of further vocational qualification at Sholom-Aleichem Priamursky State University.

3.5. Findings of Pedagogical Survey

When studying the problem of motivating students to scientific research, the authors surveyed 162 respondents to identify their aims and motivation for engaging in science. The survey consisted of two types of questions. Some of them need to answer what the scientific research is; others ask why scientific activity and participation in are necessary.

The first question asks if the respondents wish to take part in scientific research and arrange scientific events. The majority of respondents gave the affirmative answer. This means they are up for participating in this kind of activity (76.5%).

The second question made students' wish clear to participate at university social activities in general. The respondents who answered affirmatively were 77.2%.

There was a multiple choice question "What is research and development associated with?" Several options were offered: a creative activity; a chance to become self-fulfilled; an ability to earn money; a possibility of choosing a career; and other (the respondents offer their own answer). According to the answers, the authors can say that the interviewed respondents connect the scientific research to the possibility become self-fulfilled (70.9%), earnings (64.2%), and future career (58%).

The fourth question finds out since when it is better to engage students in scientific research. Finally, the greatest number of respondents (44.4%) answered "since the second year", the other answers sounded about the same (16-20%).

45 lecturers from different universities succeeded in training a online course for special purposes in order to get acquainted and apply the proposed methodology in future. The graduates were asked to leave a feedback in the end of study. The responses are positive. Here are a few of them, "There is a lot of new information despite my awareness concerning the topic", "The impressions are positive. The course is informative, useful, and professional. The content is practice-centered", "The course is effective, the knowledge is possible to apply in practice, interesting and accessible contents", "All the information is meaningful and practice- centered".

After the educators had used the designed system, it resulted in the following achievements: the students published more than 400 scientific articles, won 19 grants of various levels, participated and became prize winners in more than 50 scientific research contests. One-third of the participants in the experiment used to get a merit-based semester scholarship for scientific research regularly. They took part and won competitions for the President of the Russian Federation grants and the Government of the RF.

4. CONCLUSIONS

Summing up what has been said, the proposed methodology has received approval and it is possible to make conclusions.

1. A special course is required to train students to scientific research.

2. The content of the subject should include the following issues: the problems of scientific cognition methodology, a choice of fields and stages of the research, methods of scientific research and preparing scientific findings, rules for writing grant applications. When training such a course, it is required to perform a demo educational research project, and a student is to complete all stages of scientific research.

3. Vocational disciplines of the curriculum should be supplemented with topics related to scientific research: Current scientific research review on a discipline; Textbook and teaching aids review on a discipline; Making a review of the author's synopsis of thesis research; Making a book review; Carrying out a research project. There is also a need to stimulate the interest for this type of discipline activity by scoring better credit or exam marks.

4. Students with their combined scientific achievements should participate in competitions for higher scholarships in science and in grant applications.

5. Coursework should have an element of scientific novelty; end in a scientific article writing and presentation it at the conference.

6. Student research projects are submitted for participation in various competitions.

7. Lecturers are required to be taught the proposed methodology via a special online course.

8. Lecturers of the related department should create an atmosphere of joint participation for students and interest in their scientific research.

The developed methodology for arranging scientific research with students can be improved, scaled and used at universities in future.

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