Research Article

Arranging Student Scientific Research as an Educational Technology: The Experience of Regional Universities of Russia

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Nowadays, student scientific research is a significant component for training specialists for Industry 4.0. However, many students do not feel like wanting much to participate in this kind of activity when studying at university. Therefore, there is a challenge in facing educators, i.e., to make a climate of learning in such a way so that learners would not only be able to acquire skills, competences, and proficiencies according to their major but also be able to promote their willingness for independent search for getting new knowledge and mastering research methods and practical techniques to solve scientific challenges and analyze various information flows. The purpose of the study is to develop a methodology for arranging student scientific research, which enables to provide with skilled professional employees. To accomplish the declared goal, the authors developed the online course *The Basic Scientific Research*, the methodology for involving students in scientific research; recommendations to include special subject matters in the content of academic course, for stimulating joint studies of educators and students; and the online course on training lecturers to the technology presented. The experiment was conducted from 2014 to 2018 among students of IT and economics at regional Russian universities. 242 students and 46 lecturers took part in it. Using the developed system by educators resulted in the following achievements: the students published more than 450 scientific articles, won 28 grants of various levels, and participated and became prize winners in more than 50 scientific research contests. One-third of the participants in the experiment received a merit semester scholarship for scientific research regularly. They participated and won competitions for the President of the Russian Federation grants, the Government of the Russian Federation. Business representatives gave top marks for graduate theses. The educational technology presented in the paper is prepared for scaling and be applied at universities.

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" [1]. The main goal of higher education is to develop a learning content that ensures graduates' relevance and competitiveness in the labor market [2].

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 not only get proficiency in their major but also promote independent search for new knowledge, practise research methods, learn more about innovative techniques of solving scientific issues, and know how to analyze various information flows. The problem is that students are not quite eager to be engaged in such activities [3]. They fear difficult challenges [4, 5]. In this case, an educator is to organize scientific research with students properly [6].

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

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

In Akulenko's opinion, properly organized and structured scientific research of students while studying at a university serves for the following:

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

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

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

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

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

(vi) 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 [7].

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

(i) 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.

(ii) Systemic functional approach means that the student masters the methodology and strategy of scientific research, enhances competence in this or that field, ands further develops scientific and cognitive interests. They have posed research and training tasks to involve students in scientific activity. There is a selection of scientific literature on a certain topic, compiling an annotation of particular original sources, and their abstracts, comparing different points of view, approach 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 in solving a problem situation in learning, i.e., preparation of a problem situation, problem definition, and hypothesizing.

(iii) 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.

(iv) 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 they 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, and determine the methodological system. Then, students study scientific literature, collect empirical data, process them, draw conclusions, and make summaries [8].

It is also possible to use pedagogical methods in teaching scientific research. They are discovery learning [9], problem-based learning [10–12], inquiry learning [13–15], experiential learning [16], and constructivist learning [17, 18].

At present, many scientists are engaged in developing effective methods for teaching scientific research to students of various majors. Kamenskaya and Kamenskiy reported on organizing scientific research of philology students [19]. Vorobyeva and Ermakov focused on teaching research methods to psychology students [20]. Winn commented on the difficulties of involving students in sociological research [21]. Court and Molesworth were engaged in teaching scientific research to students in marketing [22]. Poindexter proposed a model for effective teaching of research methods for journalism students [23]. Fenwick observed the issues of teaching research methods to students of public policy [24]. Monson reviewed training through a research project [25]. Lovekamp et al. suggested using a questionnaire at the beginning of the study to help understand the content [26]. Schutt et al. outlined the objectives of the courses on

research methods [27]. Martyushev et al. considered the main trends in intensification of student scientific research in young scholars and lecturers, listed the main types of student scientific research, and suggested recommendations that would motivate students to perform scientific research [28]. Brennan et al. highlighted the themes that contribute to develop a student as a researcher [29]. Hesse and Schubert presented the content and methodology of designing a semester course research project [30]. Garner et al. showed how it is possible to encourage and provide a high quality of teaching research methods [31].

1.2. Purpose of the Study. The purpose of the study is to develop a methodology for arranging student scientific research, which enables to provide with skilled professional employees.

2. Materials and Methods

To achieve the goal of the research, it is necessary to teach students and lecturers the basic scientific research by means of specially developed online training courses published in the information network of the university. The scholars were carrying out a teaching technology via integrated methods [32] and stimulating creative initiative [33]. The content of the courses was following personal experience and criteria for students and lecturers' efficient scientific work. The effect of achieving mastery of the course was assessed in two ways: (1) through the internal testing of system and tasks (exercises); (2) through the peer review when publishing scientific papers, participating in research contests, getting scholarships according to scientific work, and taking part in grant competitions at various levels.

The author used a survey method to get feedback on the methodology developed.

Students were offered a developed questionnaire with several questions to be answered: (1) Are you ready to take part in scientific research and arranging scientific affairs? (answer: yes/no); (2) Are you ready to participate in extra-curriculum activities at the university in general? (answer: yes/no); (3) What is research and development associated with (the respondents offered their own answers) ? (a creative activity; a chance to become self-fulfilled; an ability to earn money; a possibility of choosing a career; others); and (4) Since when should students be engaged in research work? (answer: 1st year; 2nd year; 3rd year; 4th year).

Lecturers should post their feedback on the training notes (aids) at the end of the course. An additional motivation to accomplish it successfully was receiving a certificate of career enhancement.

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, Blagoveshchensk State Pedagogical University, Khabarovsk State University of Economics and Law, Sakhalin State University, and Pacific National University.

242 students of IT and economics majors including 211 undergraduate students and 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-41; 2nd year-48; 3rd year-63; 4th year-59 learners.

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

3. Results

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.

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, and 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; and studying 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), and 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, and 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, and 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 presenting 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.), and 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 and 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 [32], developing creative initiative [33]. 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 and teaching methods of their subjects on purpose and to motivate participation 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:

(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, and 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 and conferences, and provide methodological assistance in writing articles.

(7) Those projects that are well done are going to take part in various competitions and 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:

(i) 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 chooses one and should consult a teacher about what the topic includes.

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

(iii) Choosing at least 10 Russian scientific articles: the authors suggest using eLibrary and Google Scholar resources. The research should be supplied in a pattern: references according to the National standard GOST R 7.0.52008-Bibliographic reference; and URL, abstract in Russian.

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

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

(vi) Choosing at least 5 original Russian theses research: the authors suggest using eLibrary, Google Scholar, and 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 for use of eLibrary, Google Scholar, and 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, and understand what difficulties are there [5, 31].

The authors having used their own solutions and good practice [28, 31] 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 and Web of Science database; ways to look for Russian and foreign like-minded colleagues to invite them to one's scientific fruitful communication; and 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. The Results of an Educational Experiment. 242 students-volunteers (of their own free will) have completed *The Basic Scientific Research* online course. They were sent an electronic certificate after having succeeded in it.

When studying the problem of motivating students to scientific research, the authors surveyed 242 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 are necessary (Table 1).

After the educators had used the designed system, it resulted in the following achievements: the students published more than 450 scientific articles, won 28 grants of various levels, and 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 (Table 2).

46 lecturers from different universities succeeded in training an 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. 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."

4. Discussion

The findings of a survey of students that have completed *The Basic Scientific Research* online course were given below (Table 1).

Table 1: Survey results of students that have completed *The Basic Scientific Research* course.

Multiple choice questions	Released quantity
(1) Are you ready to take part in research and arranging scientific events?	
Yes	185
No	57
(2) Are you ready to participate in extra-curriculum activities at the university in general?	
Yes	188
No	54
(3) What is research and development associated with (the respondents offer their own answer)?	
A creative activity	144
A chance to become self-fulfilled	164
An ability to earn money	151
A possibility of choosing a career	137
Others	54
(4) Since when should students be engaged in research work?	
1st year	41
2nd year	101
3rd year	52
4th year	48

Table 2: Quantitative response of students that have completed *The Basic Scientific Research* course.

Index	Value
(1) The number of students that published one scientific paper (on their own or in cooperation with their teammates)	86
(2) The number of students that published two scientific papers (on their own or in cooperation with their teammates)	62
(3) The number of students that published three or more scientific papers (on their own or in cooperation with their teammates)	94
(4) A total number of scientific papers published	457
(5) The number of students applying for research grants	63
(6) The number of student research grants won	28
(7) The number of winners in student scientific competitions	54
(8) The number of students applying for a term scientific scholarship	123
(9) The number of students who had a semester scientific scholarship	87
(10) The number of students having the President of the Russian Federation or the Government of the Russian Federation grants	18

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 (76.4%).

The second question made students' wish clear to participate at university social activities in general. The respondents who answered affirmatively were 77.6%.

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 others (the respondents offer their own answer). According to the answers, the authors can say that the interviewed respondents connecting the scientific research to the possibility become self-fulfilled (67.7%), earnings (62.3%), and future career (56.6%).

The fourth question finds out since when it is better to engage students in scientific research. Finally, the greatest number of respondents (41.7%) answered "since the second year," the other answers sounded about the same (16–20%).

According to the data presented in Table 2, every student published a scientific paper. Many of them published even several papers individually or in cooperation with their teammates. This achievement is supposed to be beneficial in involving students in scientific research. It is significant to students to use those skills they had required and keep mastering them in future. It was also assessed positively by both lecturers and company representatives while interning. This is the evidence of the valuable methodology applied.

The lecturers who took the developed online course rated it positively. Monitoring such lecturers' scientific work was not a special aim of the experiment. However, according to the indirect grounds, they were also influenced positively by taking the online course. The author has arranged a social club (forum) where the issues of student research have been discussed, and a list of scientific conferences has been sent out. The colleagues found fellow thinkers. They were able to overcome the difficulty in the proposed methodology. They support each other in scientific research and events and have a lot of scientific papers come out. Participation in the educational experiment made the lecturers' scientific research more intensive.

The outcomes of the experiment depended on lecturers greatly, for they did the most part of work to implement the methodology proposed. Such facts correspond to similar studies quite well.

5. Conclusions

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

A special course is required to train students to scientific research. When training such a course, it is required to perform a demoeducational research project, and a student is to complete all stages of scientific research. Vocational disciplines of the curriculum should be supplemented with topics related to scientific research. There is also a need to stimulate the interest for this type of discipline activity by scoring better credit or exam marks. Students with their combined scientific achievements should participate in competitions for higher scholarships in science and in grant applications.

Lecturers should be taught the proposed methodology via a special online course. 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.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.
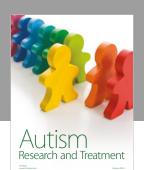
Conflicts of Interest

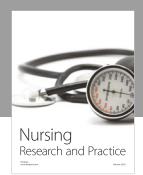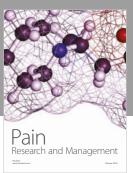The author declares that there are no conflicts of interest.

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[33] D. Luchaninov, R. Bazhenov, and N. Bazhenova, "Student's information competence development: experience and prospect," *SHS Web o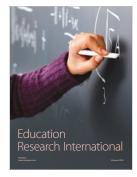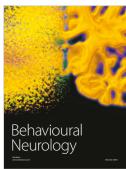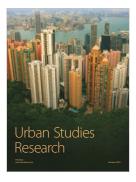f C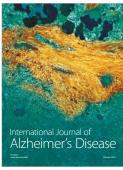onferences*, vol. 37, article 01011, 2017.