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THE ORGANIZATION OF INDEPENDENT WORK STUDENTS WHEN TEACHING INVERSE PROBLEMS FOR DIFFERENTIAL EQUATIONS

V.S. Kornilov

Moscow city pedagogical university
Sheremetevskaya str., 29, Moscow, Russia, 127521

The article notes that extracurricular independent work makes a great contribution to the development of students' scientific and cognitive potential in the process of learning inverse problems for differential equations. In the process of independent work, students not only study the educational and scientific material on inverse problems, given in the classroom, but also studied the special scientific literature, that is, scientific articles, materials of scientific conferences, published not only in Russian but also in English. At the same time, students master the scientific style of presentation of scientific material in such special literature, which differs significantly from the style of presentation of educational material in University textbooks. It is noted that during the independent work students explore a variety of inverse problems that are recommended to them by the teacher. They develop skills and abilities to independently formulate logical conclusions based on the results of the study of inverse problems.

Key words: learning inverse problems for differential equations, independent work of students, mathematical creativity of students, scientific and cognitive potential of students

Independent work of students of higher educational institutions is an important educational activity that contributes to the formation of a system of fundamental subject and scientific knowledge (see, for example, [1; 5; 6; 21; 24]). Independent work of students is carried out in extracurricular time. In the work programs of academic disciplines teachers should be prescribed hours and topics for independent work of students. Their number should be agreed with the heads of departments and Dean's office, in order to avoid academic overload students. Teachers should develop and coordinate schedules with students.

Currently, some Russian universities for students of senior courses of physical and mathematical directions of preparation are taught elective courses devoted to inverse problems for differential equations (see for example, [2; 8; 12–19]). The content of learning inverse problems for differential equations is formed on the basis of the theory of inverse and ill-posed problems, which is one of the scientific directions of modern applied mathematics (see, for example, [3; 4; 7–11; 20; 22; 23]). Since inverse problems are, as a rule, incorrect problems, the search for non-template solutions which involves a deep analysis of the physical process under study and its cause-and-effect relationships, these circumstances suggest that students of rational thinking and creative approaches both to build a system of integral equations of inverse problems, and in the future to prove theorems of existence, uniqueness and conditional correctness of the solution of inverse problems.

The above requires from students not only conscientious attitude to learning in the classroom subject knowledge on inverse problems for differential equations, but also a lot of independent work, which requires perseverance, curiosity, activity, mathematical creativity. At the same time, a great responsibility in the implementation of independent work is assigned to the teacher, leading such training sessions. During their independent work, students investigate the correctness of decisions of various inverse problems that are recommended to them by the teacher. They develop skills and abilities to independently formulate logical conclusions based on the results of the study of inverse problems.

Students may be asked, for example, to work on their own:

- perform mathematical calculations that do not require new knowledge of inverse problems that were omitted in the lecture;
- solve the inverse problem for a differential equation or another mathematical problem logically related to the described sections of inverse problems;
- read a specific scientific article on inverse problems for differential equations, which is the formulation and method of the study is close to the previously discussed in the lecture, to understand the method of its solution, to analyze the physical meaning of the most applied problems, to Express their views on the merits and advantages of the article approach to its solution.

We present approaches to the implementation of independent work of students in the learning process of inverse problems for differential equations.

Participation of students in scientific seminars on inverse problems for differential equations. This practice is implemented in a number of Russian classical universities, where departments operate on the basis of research institutes, for example, at the Novosibirsk state University. These seminars discuss new research results on the inverse problems of the employees of these research institutes, who are also teachers of these students. Visiting the seminars, students not only get acquainted with new achievements in the field of inverse problems, communicating with the participants of the seminar, but also can take part in it as a speaker, if they get new results. At the same time, students independently acquire experience and skills of research of inverse problems, performances before sometimes eminent scientists who can ask various questions to which it is necessary to be able to give the reasonable answer; they have an interest in problems of research of inverse problems. Already from the student years they are involved in research work in the field of inverse problems for differential equations.

Students work on course and final qualifying works on inverse problems for differential equations. As topics of such student research papers, students are encouraged to explore generally applied problems that are not outlined in the training courses on inverse problems for differential equations. Therefore, students need to work independently with special literature, namely scientific articles, materials of scientific conferences, monographs; attend scientific seminars. There are cases when students receive new results, which are later published in various publications. The appearance of the first publications in the student years for them is very difficult to overestimate. Subsequently, students become highly qualified specialists, and some of them become candidates and doctors of Sciences.

Participation of students in student scientific conferences. On the basis of some Russian classical universities organized student scientific conferences, which are attended by students, postgraduates, young scientists. For example, on the basis of Novosibirsk state

University in Soviet times was organized all-Union student scientific conference “Student and scientific and technological progress”, which was attended by students and postgraduates of the Soviet Union. In further she has become all-Russian. It has sections in various directions, which are headed by candidates and doctors of Sciences. Before the beginning of the conference, the participants are usually made by well-known scientists, namely, academics, doctors, professors. At this conference reports are made on inverse problems for differential equations. As a result of the conference, the best reports are noted, which are recommended for printing.

Of course, the students participating in the conference, there is interest in further research, gaining experience in speech to the audience, communication not only with their peers, but also with venerable scientists. Students participating in such conferences have the opportunity to demonstrate their results not only to other participants of the conference, but also to the organizers of these conferences, who are present during their speech. In some cases, this can play an important role for students in their further research. For example, a student, if he / she is a graduate of the University, may be offered further training in graduate school, in which he / she will engage in research work on the proposed research topic; advise to engage in research on a specific topic and further maintain scientific relationships.

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The author of this article had the honor to take part in it during his student years and can say with confidence that such student conferences play an important role for students engaged in research work, including in the field of inverse problems for differential equations. There is not only confidence in their own ability, but also an interest in further studies to gain the experience of communicating scientific interests, expanding horizons in a specific scientific area, which conducts its own studies, there may be a range of scientific Dating, which is important in research work, etc.

Writing essays by students based on scientific articles on inverse problems for differential equations. In the process of learning inverse problems for differential equations, students, as an independent work, it is proposed to read a scientific article and write a summary on it. This may be due to the small amount of hours allocated to the curriculum for a particular course of choice, which makes it impossible to consider in the classroom a particular inverse problem. But from the point of view of the integrity of training, professional orientation of training it is useful to know the students. This can also be the case when a student has a great interest in inverse problems for differential equations.

In these cases, when working on the abstract, students gain experience of independent work with special literature on inverse problems for differential equations, get used to the style of presentation of the material in scientific publications, which is much more difficult

than in teaching materials addressed to students; get acquainted with the method of solving this inverse problem, which is not found in the content of learning inverse problems.

Participation of students in research work. Students who show great interest in inverse problems for differential equations, it is advisable to involve in specific scientific projects on inverse problems. This practice is implemented in the departments existing on the basis of research institutes, for example, at the Moscow state University named after M.V. Lomonosova, Moscow Institute of physics and technology, Moscow state technical University named after N.E. Bauman, Novosibirsk national research state University and other universities. As a result, students are involved in research work, which in the future can play an important role both in teaching inverse problems, and in their further professional activities in the field of applied research.

In the process of independent work in the study of inverse problems for differential equations, students learn not only mathematical methods for solving inverse problems, but also gain experience in the construction and analysis of mathematical models of inverse problems, bringing them to a form convenient for research. Independent work contributes to the formation of students' scientific Outlook, understanding of scientific and educational and humanitarian potential of inverse problems, the awareness of gnoseological processes in applied mathematics.

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Bio Note:

Kornilov Viktor Semenovich, doctor of pedagogical sciences, candidate of physical and mathematical sciences, full professor, deputy head of the department of informatization of education of the Moscow city pedagogical university. *Contact information:* e-mail: vs_kornilov@mail.ru

ОРГАНИЗАЦИЯ САМОСТОЯТЕЛЬНОЙ РАБОТЫ СТУДЕНТОВ ПРИ ОБУЧЕНИИ ОБРАТНЫМ ЗАДАЧАМ ДЛЯ ДИФФЕРЕНЦИАЛЬНЫХ УРАВНЕНИЙ

В.С. Корнилов

Московский городской педагогический университет
Шереметьевская ул., 29, Москва, Россия, 127521

В статье отмечается, что внеаудиторная самостоятельная работа вносит большой вклад в развитие научно-познавательного потенциала студентов в процессе обучения обратным задачам для дифференциальных уравнений. В процессе самостоятельной работы студентами не только прорабатывается учебный и научный материал по обратным задачам, даваемый на учебных занятиях, но и изучается специальная научная литература, т.е. научные статьи, материалы научных конференций, опубликованные не только на русском, но и на английском языке. При этом студенты осваивают научный стиль изложения научного материала в такой специальной литературе, который существенно отличается от стиля изложения учебного материала в вузовских учебниках. Отмечается, что во время самостоятельной работы студенты исследуют разнообразные обратные задачи, которые им рекомендованы преподавателем. Нарбатывают умения и навыки самостоятельно формулировать логические выводы по результатам исследования обратных задач.

Ключевые слова: обучение обратным задачам для дифференциальных уравнений, самостоятельная работа студентов, математические творческие способности студентов, научно-познавательный потенциал студентов

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Сведения об авторе:

Корнилов Виктор Семенович, доктор педагогических наук, кандидат физико-математических наук, профессор, заместитель заведующего кафедрой информатизации образования Московского городского педагогического университета. *Контактная информация:* e-mail: vs_kornilov@mail.ru