

PROFESSIONAL EDUCATION

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Nataliia Odarchenko²**WORKBOOK AS A TOOL OF REPRODUCING METHOD FOR TEACHING
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Abstract. *The article highlights the main challenges to be solved in higher education in the modern conditions. It is shown that the implementation of these tasks is possible with the systematic inclusion of the elements of students' independent work in the teaching process. We established that one of the forms of independent work in the classes and outside teaching hours of higher mathematics discipline is the workbook. Its application allows to teach undergraduate students during the first years to acquire the knowledge independently, to actively analyse, to learn and to transform them for solving the uncommon problems. Authors discuss the workbook for the section "Integral calculus" as an example.*

Keywords: independent work; lecturer; student; teaching process; workbook

1.**Introduction**

As a result of the reform of higher education in Ukraine and implementation of the European standards, the number of teaching hours for students has sharply reduced and contrary the number of hours for independent work has increased. The higher education lecturers are facing an important problem: how to teach students to work independently? Particularly acute this problem concerns teaching in natural sciences, where reading, understanding and memorizing the text is not sufficient to find a solution to the problem, and therefore the logical construction, the abilities to critically examine and to use previously acquired skills are required.

2. Analysis of studies and publications

In accordance with the Law of Ukraine «On Higher Education" and the National Doctrine of education development the higher education lecturers face the challenge to prepare competent, highly qualified specialists capable of continuous professional growth which are in demand and competitive on the highly technological global labour market. Solving of these problems is impossible without the intensification of self-

educational component [1], the activation of planned self-cognitive activity [2-3].

Today, an independent work of students is a form of educational process on par with the work in the class and represents a substantial part of it, the main means of mastering the teaching material in the time free from mandatory lectures and seminars [4].

The problems of independent work were intensively investigated in the past (G.N. Alova, D.I. Bogoyavlenskiy M.A. Danilova, I.YA. Zyazyun, G.V. Kudryavtsev, A.M. Matyushkin, M.M. Skatkin)

In modern conditions the higher educational institutions in Ukraine have to help students to solve the following main tasks:

- search independently for the scientific information;
- transform knowledge into an integral logical system;
- efficient and creative application of knowledge to master new information and solve applied problems;
- combine training activities with the scientific research and problem solving in the corresponding production sector;

- observe and combine the facts and phenomena and predict the new trends and directions;
- develop individual creative abilities.

The successful implementation of these tasks is possible with the systematic inclusion of the elements of student's independent work in the teaching process.

The task of the teacher is to awaken interest in the material presented in a lecture, to systematically clarify certain theoretical concepts, to create favourable conditions for prompt updating of the necessary knowledge to understand facts and rules taught during the class [5].

It is necessary to help the student to solve a problem by offering a solution algorithm ensuring that the student solves several problems included in the system, and gets eventually a small victory inspiring for the new ones [6].

When talking about the modern forms and methods of teaching, it is important to note the change in position of the lecturer and the student in the learning process [6]. For the teacher it is a change from the monologue methods of presenting information to the interactive forms of communication with students, the use of online resources during the classes and providing students with materials for the individual work (elearning.sumdu.edu.ua). For the student it is an increasing level of independence in their studies and a choice of content, forms and methods of teaching.

In this regard, a model of practical training is created, as well as the use of additional techniques and methods for the organization of educational process by the teacher. This process allows activation of cognitive and reproducing student's activity. The task of the teacher is to ensure a practical realization of step-by-step implementation and assimilation of the teaching materials by students, to create a discrete feedback between students and teachers in the learning process.

Given the above, search for tools and methods to ensure the development of reproductive, reconstructive, variable, heuristic and creative skills for students' self-education is extremely important.

The aim of this work is to show the importance and necessity of using the workbooks to improve the quality of students' independent

work for studying of higher mathematics at the university level.

3. The presentation of the main material

It is known that the learning process cannot be successful unless it is accompanied by an active reproduction, knowledge and skills retention. Educational information is provided to the student in the form of lectures. Although the lectures are characterized by a large supply of new information, there is no way to control student's cognitive activity. Therefore it is necessary to use reproductive and reproducing teaching methods for practical and individual classes, that repeat the model system of actions. These methods include the workbooks developed by lecturers of the department of mathematical analysis and methods of optimization at the Sumy State University. Their use makes it possible to teach the undergraduate students during first years to acquire the knowledge independently, to actively analyse, to learn and to transform them for solving the uncommon problems.

The workbooks in the study of higher mathematics develop the students' ability and skills of logic and science-based knowledge transfer to other objects of their joint activities. The main purpose of these workbooks is a creation of favourable conditions for the individual student's work in his/her usual pace. The role of the teacher is consultancy and quality control assessment.

When using the didactic materials "Workbook" the educational information is systematized, that makes awareness and perception much easier for students. Favourable conditions for summarizing and formulation of the necessary conclusions are also created. It is important that the proposed materials allow to familiarize students with the list of tasks for independent work in accordance with the content of the lecture. It may be a specific homework tasks, a list of the methodological literature, the basic theoretical facts, the theorems, the formulas.

Below we will consider as an example the workbook for the theme "Integral calculus".

Workbook for the theme: "Integral calculus"

Main sections:

- I. The indefinite integral
- II. The definite integral
- III. The use of the definite integral

The main issues in the section:

1. Definition of the indefinite integral.
2. Properties of the indefinite integral.
3. Table of the basic indefinite integrals.
4. Basic methods of integration:
 - a) the method of direct integration;
 - b) the method of integration by substitution;
 - c) the method of integration by parts.

The function $F(x)$ is called primitive function $f(x)$ on an interval $(a;b)$, if for any $x \in (a;b)$ the following statement is correct:

The set of all primitives of a function $F(x) + C$ is called

and is denoted

Basic properties of the indefinite integral:

1. $\int af(x)dx =$ _____
2. $\int (f(x) \pm g(x))dx =$ _____
3. $\int f(kx+b)dx =$ _____

Table of the basic integrals:

1. $\int x^\alpha dx =$ _____ $\alpha \neq -1$
2. $\int dx =$ _____
3. $\int \frac{dx}{x} =$ _____
4. $\int a^x dx =$ _____
5. $\int e^x dx =$ _____
6. $\int \sin x dx =$ _____
7. $\int \cos x dx =$ _____
8. $\int \frac{dx}{\cos^2 x} =$ _____
9. $\int \frac{dx}{\sin^2 x} =$ _____
10. $\int \frac{dx}{\sqrt{a^2 - x^2}} =$ _____
11. $\int \frac{dx}{\sqrt{x^2 + a^2}} =$ _____
12. $\int \frac{dx}{x^2 + a^2} =$ _____

$$13. \int \frac{dx}{x^2 - a^2} = \text{_____}$$

The direct integration.

Example 1. Calculate

$$\int \left(3x^2 - \frac{8}{x} + x^3 \right) dx = 3 \cdot \frac{x^3}{3} - 8 \cdot \ln|x| + \frac{x^4}{4} + C = x^3 - 8 \ln|x| + \frac{1}{4}x^4 + C.$$

Example 1. (for independent work).

$$\text{Calculate } \int \left((5k+1)x^{2k-3} - \frac{8k}{x^k} + x^{k-1} \right) dx,$$

k - student number in the class list.

Example 2. Calculate

$$\int \sqrt[3]{1+3x} dx = \int (1+3x)^{\frac{1}{3}} dx = \frac{1}{\frac{4}{3}} \cdot \frac{(1+3x)^{\frac{4}{3}}}{\frac{4}{3}} + C = \frac{1}{4} \sqrt[3]{(1+3x)^4} + C.$$

Example 2. (for independent work).

$$\text{Calculate } \int \sqrt[3k-1]{1+(2k+1)x} dx.$$

Example 3. Calculate

$$\int \frac{dx}{6x+1} = \frac{1}{6} \ln|6x+1| + C.$$

Example 3. (for independent work).

$$\text{Calculate } \int \frac{dx}{(8k-1)x-4}.$$

Example 4. Calculate

$$\int \sin(9x+7) dx = -\frac{1}{9} \cos(9x+7) + C.$$

Example 4. (for independent work).

$$\text{Calculate } \int \cos((5k+3)x-3) dx.$$

$$\text{Example 5. Calculate } \int e^{6x-4} dx = \frac{1}{6} e^{6x-4} + C.$$

Example 5. (for independent work).

$$\text{Calculate } \int e^{(1-3k)x+5} dx.$$

Example 6. Calculate

$$\int \frac{dx}{9x^2 + 3} = \frac{1}{9} \int \frac{dx}{x^2 + \frac{3}{9}} =$$

$$= \frac{1}{9} \int \frac{dx}{x^2 + \frac{1}{3}} = \frac{1}{9} \cdot \frac{1}{\sqrt{\frac{1}{3}}} \cdot \operatorname{arctg} \frac{x}{\sqrt{\frac{1}{3}}} + C.$$

Example 6. (for independent work).

Calculate $\int \frac{dx}{(2k+3)x^2 + k}$.

Example 7. Calculate

$$\int \frac{dx}{\sqrt{4-7x^2}} = \int \frac{dx}{\sqrt{7} \cdot \sqrt{\frac{4}{7}-x^2}} =$$

$$= \frac{1}{\sqrt{7}} \cdot \arcsin \frac{x}{\sqrt{\frac{4}{7}}} + C.$$

Example 7. (for independent work).

Calculate $\int \frac{dx}{\sqrt{(3k+2)-(5k-1) \cdot x^2}}$.

Example 8. Calculate

$$\int \frac{dx}{\sqrt{9x^2 + 2}} = \int \frac{dx}{3\sqrt{x^2 + \frac{2}{9}}} =$$

$$= \frac{1}{3} \int \frac{dx}{\sqrt{x^2 + \frac{2}{9}}} = \frac{1}{3} \ln \left| x + \sqrt{x^2 + \frac{2}{9}} \right| + C.$$

Example 8. (for independent work).

Calculate $\int \frac{dx}{\sqrt{(7k-2)x^2 - (3k+1)}}$.

Example 9. Calculate

$$\int \frac{dx}{3x^2 - 7} = \int \frac{dx}{3\left(x^2 - \frac{7}{3}\right)} = \frac{1}{3} \int \frac{dx}{x^2 - \frac{7}{3}} =$$

$$= \frac{1}{3} \cdot \frac{1}{2\sqrt{\frac{7}{3}}} \ln \left| \frac{x - \sqrt{\frac{7}{3}}}{x + \sqrt{\frac{7}{3}}} \right| + C.$$

Example 9. (for independent work).

Calculate $\int \frac{dx}{(2k+1)x^2 - (3k+2)}$.

Example 10. Calculate

$$\int \frac{1 + \cos 6x}{2} dx = \frac{1}{2} \int (1 + \cos 6x) dx =$$

$$= \frac{1}{2} \left(x + \frac{1}{6} \sin 6x \right) + C.$$

Example 10. (for independent work).

Calculate $\int \sin^2(4k-3) x dx$.

Further the authors have created the other problems for students to practice the calculus methods such as integration by substitution, by parts, integration of the functions containing square trinomial, trigonometric, rational and irrational functions. There is more space allocated for calculation in the original workbook.

The use of such didactic materials diversifies students' independent work on practical and individual classes. The classes have been proven as an effective form of learning activity for the inclusion of all students in the feasible activities. These workbooks are accessible by using local university's network.

To enhance the efficiency of use of the workbook on each lesson the teacher identifies the tasks and the organization of work, as well as discusses theoretical questions that have to be learned together with the students.

Summarizing our proposed principles and methods of selection of material for the "Workbook", we can assume that their didactic purpose is characterized by three interrelated functions: scientific organization of work of the lecturer and the student; creation of the necessary visual support and interpretation for verbal explanations of the teacher; organization of the students' independent work while studying a new topic.

4. Conclusions

From the above discussion, we can determine the tasks that didactic materials "Workbooks" help to solve :

- students' knowledge revision and retention;
- acquisition of the independent work skills;

- development of skills to work with the special literature;
- development of skills to build an algorithm for solving problems;
- formation of skills to make generalizations and conclusions;
- activation of cognitive activity of students.

Analysis of the content and purpose of the didactic materials gives reason to believe that improvement of the practical trainings methods can be done by introducing in the teaching process the workbooks and by treating them as a didactic elements of the learning process structure, which is based on the principles of activating students' independent work. In this case, the concept of "self-study" implies not only a process of efficient knowledge reproduction and their application to solve the problems, but also an accomplishment of individual tasks related to the certain changes in objective reality. During this activity the assimilation of new knowledge is exercised, the creative abilities are developed and student is formed as an "independent personality". Thus the student can perform in the future in the absence of a direct and continuous guidance.

During the classes the teacher guides students' independent work indirectly or directly by instructive method. The latter is determined by the teacher depending on the level of cognitive abilities of the students. We can assume that the independent work of students in the classes using the workbook is to some extent a way or form of organizing the students' actions that are aimed at achieving the goals and objectives under the guidance of the teacher.

The workbooks are offered to the full-time students to study the main sections of the course

"Higher Mathematics". In the future, they can be implemented in the teaching process of correspondence and distance learning students.

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І.О. Шуда¹, Н.І. Одарченко². Робочі зошити як засіб відтворювального методу навчання математики в університеті

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Самостійна робота студента – основний спосіб опанування навчального матеріалу в позаурочний час, на яку відводиться 2/3 часу, відведеного на вивчення дисципліни.

У статті виділені основні завдання, які вирішує вища школа у сучасних умовах. Показано, що реалізація цих завдань можлива при систематичному включенні в навчальний процес елементів самостійної роботи студентів. Встановлено, що однією з форм самостійної роботи на заняттях і в позаурочний час є, розроблений викладачами Сумського держуніверситету, робочий зошит. Його використання надає можливість навчити студента початкових курсів самостійно отримувати знання, активно аналізувати і засвоювати, а також уміти трансформувати їх для вирішення нетрадиційних проблемних завдань.

Авторами роботи визначені дидактичні цілі даних матеріалів, які включають повторення вивченого матеріалу, закріплення знань і умінь студентів за даною темою, набуття навичок самостійної роботи, розвинення умінь роботи із спеціальною літературою.

Дані робочі зошити використовуються при вивченні основних розділів вищої математики. Доступ до них мають студенти в Інтернет ресурсі на сайті університету. Як приклад розглянутий розділ «Інтегральне числення».

Однією з переваг у використанні даних дидактичних матеріалів є диференційований підхід у навчанні, що дозволяє здійснювати індивідуальний підхід до студентів, враховуючи їх різні здібності.

Такі робочі зошити запропоновані студентам денної форми навчання для вивчення основних розділів курсу «Вищої математики». Надалі їх доцільно використовувати і для студентів заочної та дистанційної форми навчання.

Ключові слова: викладач; навчальний процес; робочий зошит; самостійна робота; студент

И.А. Шуда¹, Н.И. Одарченко¹. Рабочие тетради как средство воспроизводящего метода обучения математики в университете

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Самостоятельная работа студента – основной способ овладения учебным материалом во внеурочное время, на которую отводится 2/3 часов, отведенных на изучение дисциплины.

В статье выделены основные задачи, которые решает высшая школа в современных условиях. Показано, что реализация этих задач возможна при систематическом включении в учебный процесс элементов самостоятельной работы студентов.

Установлено, что одной из форм самостоятельной работы на занятиях и во внеурочное время является, разработанная преподавателями Сумского госуниверситета, рабочая тетрадь. Ее применение дает возможность научить студента начальных курсов получать самостоятельно знания, активно анализировать и усваивать, а также уметь трансформировать их для решения нетрадиционных проблемных заданий.

Авторами работы определены дидактические цели данных материалов, которые включают повторение изученного материала, закрепление знаний и умений студентов по данной теме, приобретение навыков самостоятельной работы, развитие умений работы со специальной литературой.

Данные рабочие тетради используются при изучении основных разделов высшей математики. Доступ к ним имеют студенты в Интернет ресурсе на сайте университета. В качестве примера рассмотрен раздел «Интегральное исчисление».

Ключевые слова: преподаватель; рабочая тетрадь; самостоятельная работа; студент; учебный процесс.

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