# THE USE OF A HIGHER MATHEMATICS ELECTRONIC INSTRUCTIONAL AND METHODOLOGICAL PACKAGE WITHIN INCLUSIVE LEARNING ENVIRONMENT

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***Abstract:*** *The article shows the need for developing a higher mathematics electronic instructional and methodological package for students with special needs. Structural elements of the above package have been described. The distinctive features of each of them have been identified. The purpose of creating a higher mathematics electronic instructional and methodological package is to ensure the formation of mathematical competence of inclusive groups' students. The efficiency of the package developed has been corroborated by the experimental data. The article may be interesting for teachers of institutions of higher education with inclusive learning framework.*

***Keywords:*** *electronic instructional and methodological package, inclusive learning, student with special needs, higher mathematics, learning*

## INTRODUCTION

At the present stage of the education development in Ukraine, the problem of acquiring higher education by persons with disabilities is becoming ever more important. The research done by scientists demonstrates that, when enrolling into higher education institutions and while studying there, young physically impaired Ukrainians encounter various kinds of difficulties [1-5]. Among them are the lack of proper educational and methodological support as well as software and information one, the lack of special equipment, the insufficient level of training for specialists working with the said category of students and architectural inaccessibility of buildings and classrooms. The teaching process is often carried out without the health peculiarities of students being taken into account, and is not distinct by its high efficiency. All that encourages teachers to find new ways to solve the problem outlined. The implementation of inclusive learning pertains to the main trends of the development of the modern educational practices. The inclusive learning is increasingly recognized as the most optimal and promising learning model for persons with special needs. One of the conditions of the efficient organization of the inclusive learning, of physical and mathematical disciplines in particular, for physically impaired students is the application of the electronic instructional and methodological package (EIMP).

## MATERIALS AND METHODS

The study is based on the use of a set of techniques. Among them are the study and analysis of the state of problem of inclusive learning organization for physically

impaired students; synthesis method, which is the basis for the creation of the electronic instructional and methodological package that takes into account the teaching of physically impaired students in the inclusive environment; systematization and generalization of theoretical and empirical data regarding the education of persons with special needs; teacher observations, questionnaire surveys, individual interviews with students, and the analysis of the students' performance.

## RESULTS

The EIMP developed covers two branches of the higher mathematics, viz. "Linear and Vector Algebra" and "Analytical Geometry". The package contains a working curriculum, theoretical information on each subject, teaching materials for practical classes, self-guided work tasks for students, selection of practice-tailored mathematical problems, glossary reference book, the Microsoft Power Point and Smart Notebook electronic teaching aids, materials for the summary academic test paper, an electronic library to match the subjects in question, a guide on the EIMP use, etc. Most of the EIMP items are available on the https://matematyka.gnomio.com website.

At the beginning of each subject, a plan of its study is presented. Theoretical information is accompanied by the self-check questions that make it possible to determine the level of assimilation of the material studied.

Teaching materials for practical learning include tasks to be solved in class and those for homework. The level of difficulty increases with each task. Besides the main tasks, additional ones were selected that can be offered to students with a high level of knowledge for self-guided solution. The problem solutions are also available in a separate portion of the material. Such kind of separation allows students with a higher level of knowledge to work in a self-guided manner, faster than others, turning to ready-made solutions only as a self-check measure. For students with a lower level of knowledge or for students with special needs, the availability of ready-made solutions facilitates understanding of the solution procedure and the substance of the task at hand, etc. Thus, each student can work at an individual pace, as it best suits his/her capabilities. Therefore, the realization of the principle of individualization and differentiation of learning comes about.

The EIMP contains self-study work items for students. Each of those items involves 8 variants. They can be used both to check the level of mastering a particular subject and to exercise in a self-supporting manner acquiring certain practical skills. In order to implement the principle of professional orientation of learning, practice-tailored mathematical problems have been selected, based on the assumed knowledge by the students of relevant subjects. The EIMP contains examples of solving such problems while problems for self-guided solution are presented separately.

The electronic teaching demonstration materials (Power Point presentations) are based on theoretical information used for lectures. Above all, they should be used by the students during the self-study of educational material. The presentations do not contain examples of how to solve problems, but rather contribute to illustrating the educational information. The material is divided into logically complete parts, each of which is incorporated into a separate slide. Some mathematical information

is presented as charts and summary tables. Many presentation objects are accompanied by animation effects allowing students to focus on the key elements of an image, to visually highlight important parts of the text (e.g. formulas, rules, theorem statements) and to understand the sequence of certain actions, etc.

All presentations are made in the same style. Calm colors predominate, high contrast text and background (mainly black lettering on a white background) are maintained and sufficient size sans serif fonts are used that are easily perceived when seen on the screen. Principal concepts and theorems are in bold type.

Presentations contain tasks of the research nature. Specifically, students are asked to find out a relationship between the position of mathematical objects on the plane (in space) and the coefficient values of relevant equations. A system of instructions has been elaborated to perform research tasks. It should be noted that an Internet connection is required for some of the tasks to be performed.

The Smart Notebook electronic materials are expedient to be used as a support for workshops, which provides the possibility of duplication of teacher's oral explanations by the written ones, of the writings on the whiteboard by the printed ones, helps to reduce the amount of mechanical work by the teacher and students, etc.

Using the Smart Board technology, a system of oral tasks has been developed for updating students' basic knowledge. The Smart Notebook electronic teaching materials package is a kind of electronic workbook. It has a number of advantages as compared to a printed one: the possibility of zooming the page; the possibility of making additional records and explanations and removing them later without changing the main text; the possibility of moving items and mathematical objects; the possibility of simultaneously displaying two consecutive pages (e.g. a solution and the explanation thereto or a solution and the verification thereof); the possibility of covering a portion of the information by a "veil" and then making that portion seen on the screen again at a certain stage of the learning process, etc. The efficiency of mastering by the students of the proposed higher mathematics subjects can be verified by conducting a summary test consisting of theoretical and practical parts. The summary test is set out in two versions. Both the theoretical and the practical part is complete with tables, which graphically illustrate the scoring system for each correctly performed task and the relations between scores gained and grades received.

All the EIMP items are represented by way of a hierarchical structure. Access to each of them is done through the "Content" tool and a system of hyperlinks. The representation of all teaching materials electronically ensures the possibility of editing text according to the needs of students. In particular, that applies to font resizing, re-coloring, re-contrasting, restyling, etc. The higher mathematics EIMP for teaching students with health disorders has certain distinctive features. Firstly, it is worth noting the EIMP's flexibility that lies in ensuring the possibility of operating it remotely at a convenient time for the student, e.g. when working through the learning material. Secondly, the development of the EIMP is based on the principle of universal design, which allows for a possible adaptation of the appearance of teaching material to the specific needs and abilities of students. Thirdly,

the EIMP can provide distance learning framework for physically impaired students, since health problems for such students can hinder the latter's systematic attendance of classes. The experimental research has been conducted using the facilities of the State Higher Educational Institution "Kryvyi Rih National University", Kremenchuk Mykhaylo Ostrogradskyi National University, Kryvyi Rih Metallurgical Institute of the National Metallurgical Academy of Ukraine and the National Metallurgical Academy of Ukraine. The research involved 38 students with special needs. The results of the experimental work provide evidence of the efficiency of the higher mathematics inclusive learning process by students with special needs, that process being based on the use of the electronic instructional and methodological package developed.

Thus, at the end of the experiment, not a single student admitted to having difficulties with taking notes of the teaching material in class, so that problem can be considered fully solved. 57.9% of students noted a decrease in the need for additional explanations by the teacher. 86.8% of students say that most of their special educational needs were met. According to the students polled, the use of information and communication technologies (ICTs) in higher mathematics classes enhances the interest in learning (81.6%), increases the visual quality of the teaching material (63.2%), and makes the perception of that material easier (73.7%). Only one student (2.6%) said that the ICTs do not affect the learning process. Not a single student has expressed a negative attitude to the application of the ICTs in the higher mathematics learning process. As for the difficulties finding information materials to prepare oneself for higher mathematics classes, all students gave a negative answer. 71.1% of students consider the higher mathematics learning achievements monitoring system flexible enough. 84.2% of students are satisfied with their higher mathematics learning results (They note the emergence of interest in learning, the desire to acquire new knowledge, the fact that the perception and understanding of the teaching material have become easier through its presentation in graphic form, etc.) 15.8% of them are partially satisfied. The results submitted are graphically represented as a linear diagram (*Figure 1*).

## DISCUSSION AND CONCLUSION

As can be seen from the above, the use of the higher mathematics EIMP for the inclusive learning by physically impaired students provides them with the full access to information sources and educational information; helps illustrate educational information and therefore assimilate scientific facts by the students in a more profound manner; makes it possible to manage the information flow highlighting the most important and complicated items of the educational material; creates opportunities to take into account students' special educational needs in substantial measure, etc.

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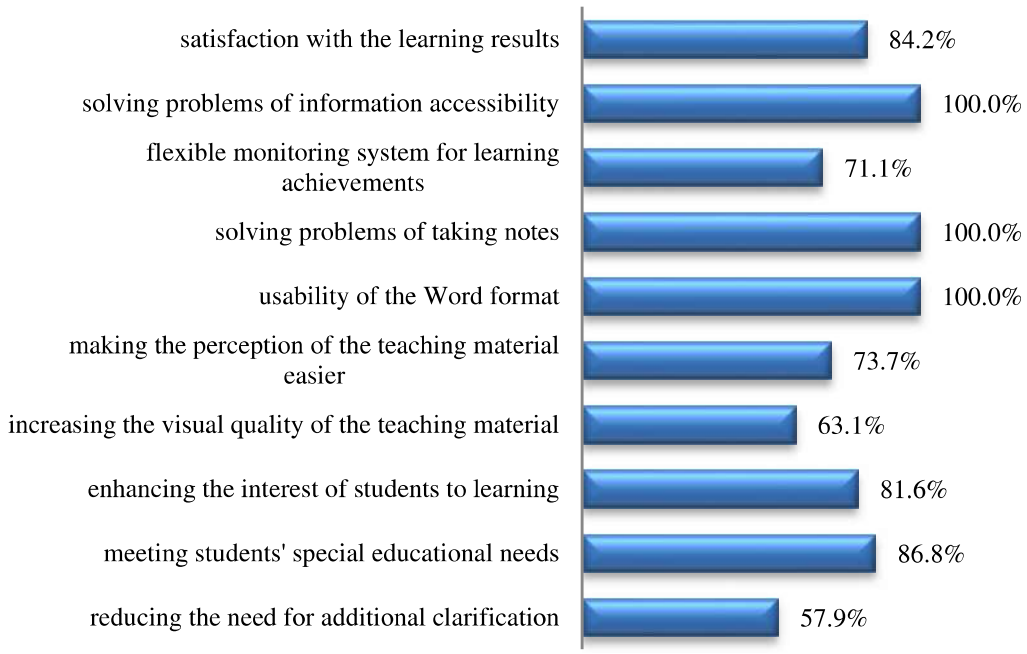


**Figure 1: The students' opinions percentage-wise on the use of the electronic instructional and methodological package**

*Source: created by author*

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