THE USE OF ADAPTIVE LEARNING IN THE STUDY OF NATURAL AND MATHEMATICAL DISCIPLINES AS A MEANS OF DEVELOPING STUDENTS' INDEPENDENCE

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Abstract: One of the ways to improve the quality of general education is the development of science-based methodological systems for teaching mathematics, the activation of the educational process, the optimization of pedagogical and cognitive activities of students, the development of their creative potential, the strengthening of the role and importance of the teacher in the independent and individual work of students with innovative pedagogical technologies in the educational process. The introduction of new adaptive learning technologies into the educational process, based on computer support for an independent pedagogical and cognitive activity, opens up prospects for expanding and deepening the theoretical knowledge base. It integrates pedagogical disciplines and differentiates learning, intensifying the educational process. It activates educational and cognitive activities, expanding opportunities for communication between students and teachers. It increases the share of independent educational activities, revealing the creative potential of all subjects of educational activities. The purpose of the academic paper is to reveal the features of using various adaptive learning tools for forming students' independence skills in the process of mastering natural sciences and mathematical disciplines. Methodology. In the process of fulfilling this scientific work, an analytical method was used to study literary sources on applying adaptive learning technologies and the developing independence of education seekers, as well as an online survey for the practical clarification of certain aspects of using adaptive learning tools in classes in natural sciences and mathematical disciplines. Results. Based on the research results, the main directions of studying the issue of developing students' independence from the perspective of using the adaptive tools in the educational process when mastering natural sciences and mathematical disciplines by the education seekers have been established. Along with this, the advantages of individual adaptive learning tools have been clarified, and possible ways to improve natural science and mathematical education have been outlined from the viewpoint of the main possibilities of their application.

Keywords: independent work, adaptive learning tools, improving the quality of natural sciences and mathematical education, forms of organization of independent work, use of an adaptive learning system.

1 Introduction

Classes in mathematical disciplines can significantly increase the level of intellectual development of pupils and students when they obtain education in any specialty. Mathematical classes aim to develop the education seekers' logical thinking, provide a basis for acquiring scientific activity skills. At the same time, the implementation of personal qualities and acquisition of the abilities mentioned above by pupils and students requires intense and systematic independent work (Lim et al., 2022).

The necessity and importance of independent work while mastering the natural and mathematical disciplines is dictated by their research and experimental nature. At the same time, when organizing independent learning activities of education seekers, it is important not only to achieve success in mastering knowledge but also to teach pupils and students to manage their own learning and independently organize their own acquisition of skills and abilities (Ryan & Deci, 2020).

Considering that the share of independent work in education has increased significantly in the past few years, the ability to organize one's own learning activities in a quality manner is a significant indicator of erudition and an important prerequisite for acquiring professional skills in the future (Ho & Lim, 2021).

The theoretical sections of the present academic paper contain a discussion of the concepts and components of independent work of students, characteristics and main directions of the teacher's activities in the process of preparing to natural science and mathematics classes, assignment of education seekers' active independent work in the process of studying natural science and mathematical disciplines have been considered.

The practical sections of the scientific work represent the results of the conducted survey regarding the reasons for the insufficient using the adaptive learning tools in the study of natural science and mathematical disciplines at general educational institutions. At the same time, the viewpoint of the respondents regarding the prerequisites for spreading the adaptive tools in mastering natural science and mathematical disciplines has been determined. The most defining types of the goal of education seekers' work on independent study of subjects have been outlined. The evaluation of the effectiveness of adaptive forms and learning tools in independent mastering natural science and mathematical disciplines by secondary education seekers has been provided.

Based on the research results, conclusions were made regarding the viewpoints of the respondents on the issues raised. The main reasons for the insufficient use of adaptive learning tools in studying natural science and mathematical disciplines in general educational institutions are insufficient assessment of the social importance of improving the quality of natural science and general mathematics education and the lack of teachers' skills regarding applying the adaptive learning tools in order to optimize the independent work of students when mastering natural science and mathematical disciplines. At the same time, there are the factors determining the active spread of adaptive learning tools in the study of natural science and mathematical sciences. They are the growing urgent need to improve the management of students' independent work in the process of their natural science and mathematical education, the emergence and active dissemination of innovative approaches towards implementing the adaptive learning tools based on using modern ICT tools. The survey has shown that the students' independent work in studying the disciplines of natural science and mathematical spectrum is organized with the aim of increasing the general level of awareness and improving competence skills, and forming practical personal skills, the ability to overcome difficulties, and the formation of will and character. Moreover, an analysis of the effectiveness of individual adaptive forms and learning tools in independent mastering natural science and mathematical disciplines, carried out as a result of the survey, has shown that the most promising of them are as follows: preparation for classes, advancing knowledge, solving problems independently or doing homework, preparing for practical classes and conducting them, performing cases and various types of practical tasks.

2 Literature Review

Currently, the independent educational activity of education seekers is a fairly common area of work of scientists conducting studies on the quality of various types of training (Liao & Wu, 2022).

According to the definition of D. Taylor and M. Yeung (2021), "independent educational work of students – various types of

individual and collective educational activities of schoolchildren, which are carried out by them in educational classes or at home with the tasks of the teacher, under his guidance, but without his constant participation. The implementation of these instructions requires active mental activity on the part of students, independent performance of various cognitive tasks, and application of previously acquired knowledge".

Needless to say that improving the skills of independent work is the subject of the efforts of education seekers; however, the issue of effective tutoring during the independent work of students during their mastery of natural and mathematical disciplines requires additional study (Tesene, 2018).

Adaptive learning from the perspective of its applying for the development of students' independence is a multi-stage process. It is implemented with the use of the relevant ICT tools at each stage. This makes it possible to achieve a new quality of education, namely, to obtain high results from the characteristics as follows:

- the level of knowledge and skills of the future teacher, necessary for independent work;
- the flexibility of the educational process, which is manifested in the fact that, based on the analysis of the accumulated experience of applying a certain type of independent work and data on its effectiveness, gradual involvement of the student to greater independence is carried out;
- the effectiveness of training, which provides the possibility of monitoring the process of completing the task and the availability of communication resources; this makes it possible to receive and provide targeted help, recommendations, etc. to the education seekers;
- transparency of education, demanding openness of requirements towards the results of independent work, criteria for their assessment, rating indicators of the child's educational achievements (Feng, Cui & Wang, 2018), (Aslan, 2021), (Moreno-Guerrero et al., 2020).

The main thing in the work of a teacher during teaching natural science and mathematics is to organize the educational process in such a way as to create a communication environment that will ensure effective independent work of education seekers, while effectively using software tools and interactive resources (Álvarez-Rodriguez, Bellido-Márquez & Atencia-Barrero, 2019).

The development of electronic technologies facilitates access to information sources, enables wider and effective communication and creates new prerequisites for effective independent work of education seekers. The issue of developing new methods and searching for the latest tools of independent educational activity is becoming more and more relevant (Cole, Swartz & Shelley, 2020).

3 Aims

The purpose of the research is to determine the position of teachers and schoolchildren' parents regarding the features of using adaptive learning tools to develop students' independence in the process of mastering natural science and mathematical disciplines.

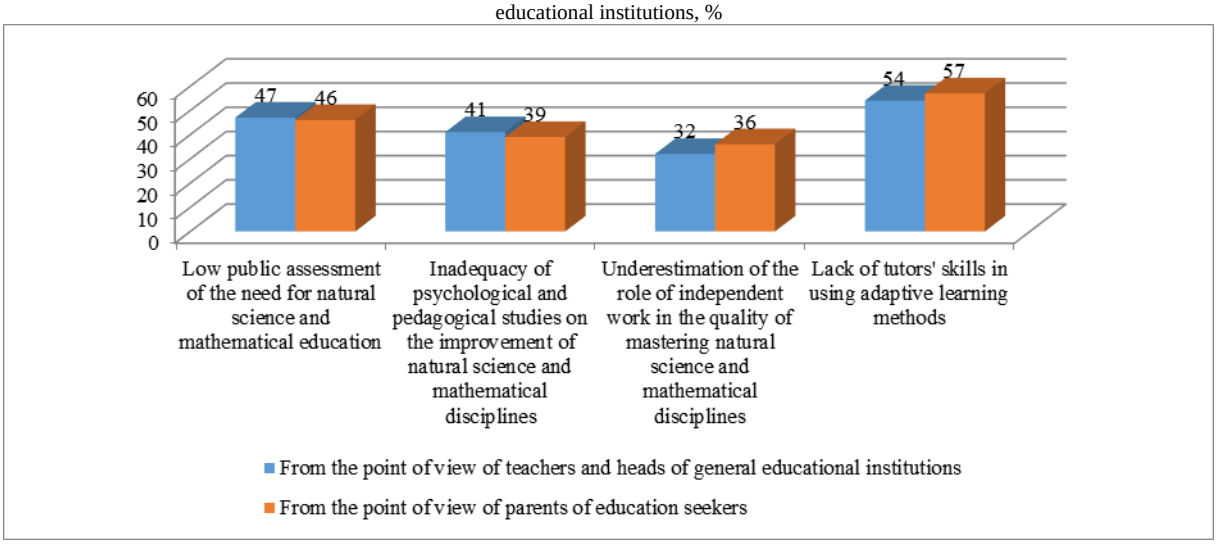
4 Materials and Methods

The practical research of using the adaptive learning tools in the study of natural science and mathematical disciplines was conducted by surveying 211 teachers of natural science and mathematical disciplines of general secondary educational institutions, as well as 164 parents of schoolchildren receiving education in general educational institutions of the Volyn and Rivne in Ukraine. In the process of organizing the survey, the authors have used the Survey Planet service.

5 Results and Discussion

Currently, in the conditions of the active development of adaptive learning technologies, there are the following reasons for their insufficient applying the tools for training students' independence towards mastering natural science and mathematical disciplines (Figure 1).

Figure 1: Reasons for insufficient use of adaptive learning tools in studying natural science and mathematical disciplines in general educational institutions, %



Source: compiled by the authors.

As the survey has shown, the most important obstacles in applying these types of tools are an insufficient assessment of the social importance of improving the quality of general natural science and mathematical education and the lack of teachers' skills in using adaptive learning tools in order to optimize the independent work of students when mastering natural science and mathematical disciplines.

Along with this, it is expedient to highlight the factors contributing to the activation of using the adaptive learning tools, namely (Figure 2):

- growing urgent need to improve the management of students' independent work in the process of natural science and mathematics education;

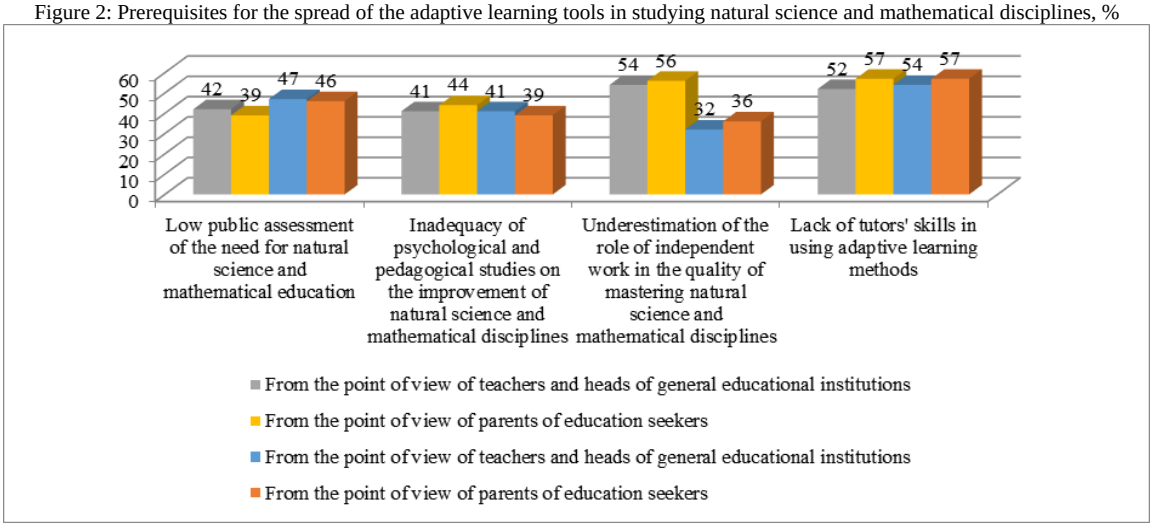
- the emergence and active dissemination of innovative approaches to implementing the adaptive learning tools based on using modern ICT tools.

The analysis of the results of the conducted survey gives reasons to assert that the independent work of students in studying the disciplines of natural science and mathematical spectrum is organized with the goals as follows (Figure 3):

- increasing the general level of awareness and improving competence skills;
- formation of practical personal skills, ability to overcome difficulties, cultivation of will and character.

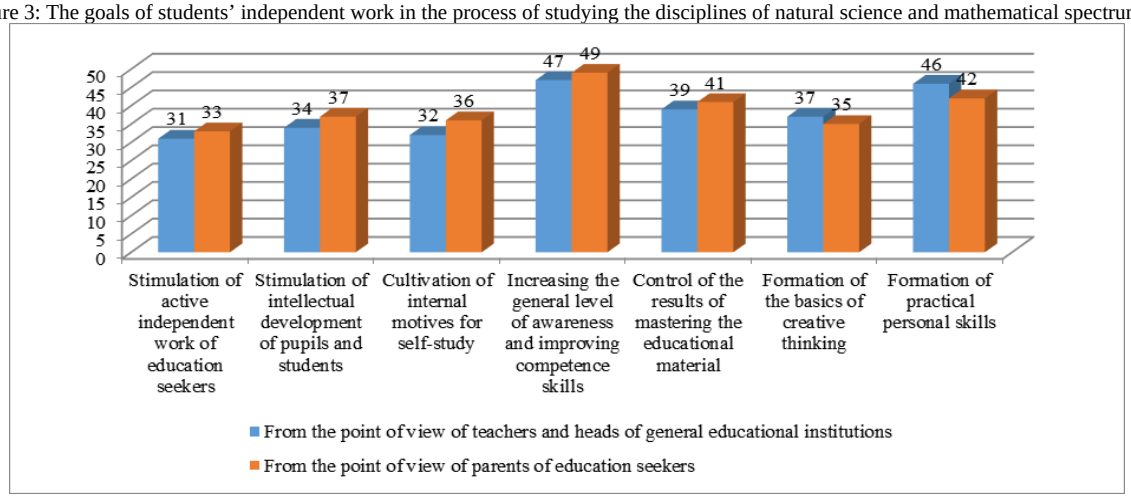
By the way, the analysis of the effectiveness of individual adaptive forms and tools of learning in the independent mastering natural science and mathematical disciplines, conducted as a result of the survey, has revealed that the most promising of them are as follows (Figure 4).

Figure 2: Prerequisites for the spread of the adaptive learning tools in studying natural science and mathematical disciplines, %



Source: compiled by the authors.

Figure 3: The goals of students' independent work in the process of studying the disciplines of natural science and mathematical spectrum, %



Source: compiled by the authors.

- preparation for classes (seminars, practical works);
- extending knowledge; independent solving of problems or doing homework;
- preparation for practical classes and their conducting;
- implementation of cases and various types of tasks.

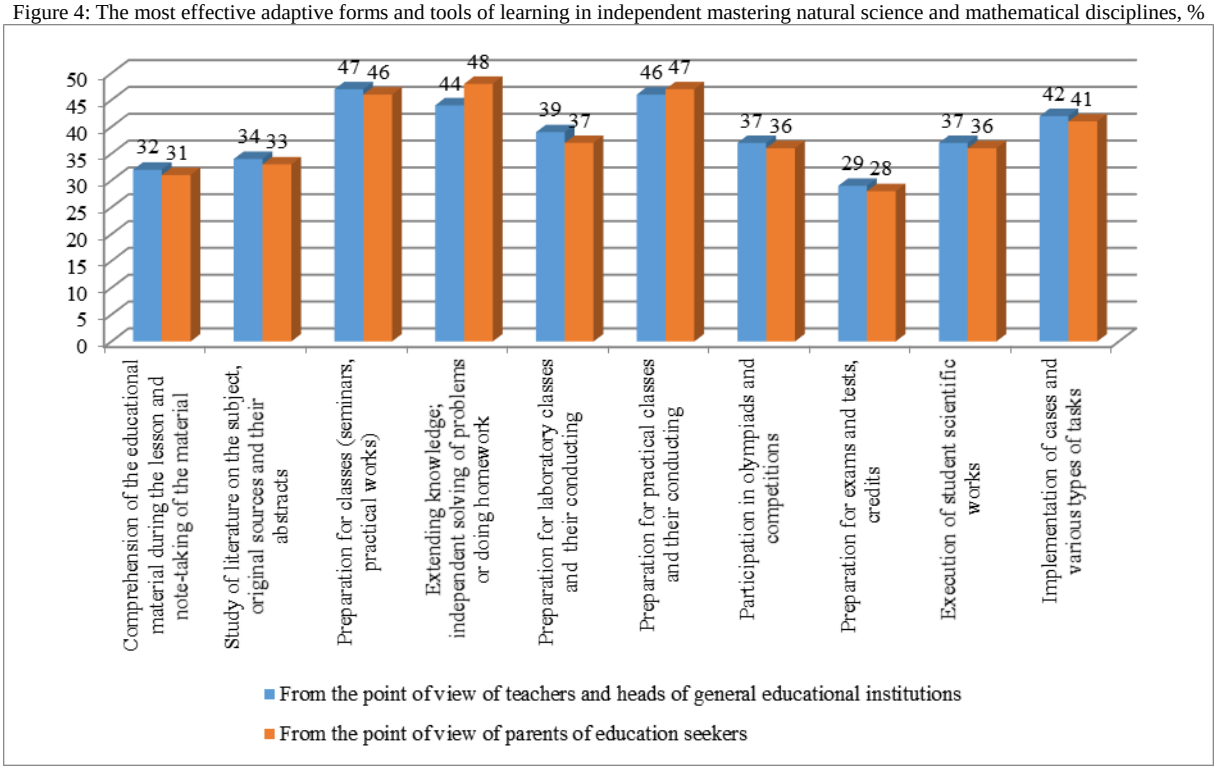
As an integral part of the educational process, the student's independent work to a great extent determines the quality of his training. Under the conditions of effective organization of independent educational activities of education seekers, cognitive aspirations and goals are effectively formed. Personal qualities such as will, attentiveness are developed, creative and professional abilities, cognitive skills are cultivated (Hamutoglu, Savasci & Sezen-Gultekin, 2019).

Self-study skills are an important factor in successful education. In addition, pupils' and students' self-studies in principle significantly enhance the educational process, intensifying the educational work of education seekers and contributing to the development of intellectual abilities (Al-Fraihat, Joy &Sinclair, 2020).

At the same time, it should be emphasized that self-studies can be the most useful and effective only if they are optimally included in the overall system of organizing the educational process (Chau, Law & Tang, 2021).

The goal of the independent educational work of the participants of the educational process is the formation of their interest in the subject of study, stimulation of the development of skills of an active, mental, cognitive and professional nature, as well as the necessary competencies. In the process of organizing students' independent work, it is significant to form a positive attitude of education seekers towards independent performance of exercises, set relevant requirements, create the necessary conditions and provide them with information about adequate techniques for independent educational activities (Liu et al., 2018).

Figure 4: The most effective adaptive forms and tools of learning in independent mastering natural science and mathematical disciplines, %



Source: compiled by the authors.

The increased level of complexity of natural science and mathematical subjects makes it necessary to take into account the individual qualities of education seekers. At the same time, it is essential to select effective adaptive methods of managing educational work taking into account the characteristics of the participants of the educational process (Kim, Nimrod & Maccann, 2018).

The distinguishing feature of natural science and mathematical disciplines is that tasks, explanations and solutions to the main educational assignments have already been developed, described in detail, explained and published on specialized sites, forums, etc. (Wang et al., 2021).

Due to the high level of development of mathematical modeling in natural and mathematical sciences, the use of computer tools is a necessary element of professional activity in the relevant scientific and industrial fields. Independent mastering of natural science and mathematical disciplines by students or pupils should take place, taking into account the requirements and conditions of nowadays, using the latest information and computer tools. These acquired work skills will be useful to students during further work (Kim, Nimrod & Maccann, 2018).

The specificity of students' independent work in natural science and mathematical education is determined by its mainly research-experimental nature, which involves determining the purpose of learning, specifying tasks, and choosing a research method and relevant tools. At the same time, an important task of managing students' independent work is not only to increase its effectiveness but also to promote the activation of the student's participation in planning his independent work.

6 Conclusions

Therefore, the conducted research has made it possible to find out that the main features of education seekers' self-study in mastering the disciplines of natural science and mathematical cycle, which consist in as follows:

- a significant share of research and educational activities;
- a gradual transition in the process of mastering a discipline from cognitive to partially search-creative methods of learning;
- high systematicity and, at the same time, dynamism of the educational material;
- the necessity to implement an individual approach toward choosing learning methods and the level of tasks for each student;
- periodic need for timely, targeted assistance to the student;
- active use of computer tools during independent work.

Adaptive technologies are an integral part of the educational process, which significantly increases the overall effectiveness of education and contributes to the students' overall personal development.

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Primary Paper Section: A

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