

**IMMERSIVE EDUCATIONAL TECHNOLOGIES AS A PART OF THE  
IMMERSIVE MATHEMATICAL ENVIRONMENT OF A STUDENT**

In recent years, the issue of educational losses has been raised in both the global and Ukrainian educational space; researchers are looking for ways to overcome them, ways to organize the learning process in such a way as to minimize these losses, and make the learning process productive, interesting and rich.

In the educational space of Ukraine in the last two years, the organization of the learning process has been highly dependent on the conditions and location of students, teachers, and educational institutions in general within Ukraine. Scientific studies conducted in Ukraine on the issue of educational losses show that the level of educational achievements of students has decreased significantly owing to the fact that students have to study most of the educational material independently [1].

Subjects of the mathematical curriculum in secondary education institutions are one of the basic and most difficult subjects for self-study. This necessitates creating a mathematical educational environment for students that will provide them with an opportunity to create conditions for immersing completely in the subject in order to master educational information independently.

Notably, even before the introduction of information and communication technologies into the process of organizing education, technologies of complete immersion into the subject of study were considered among the most effective and productive ones in achieving a positive learning result, especially when learning foreign languages. With the introduction of information and communication technologies into the educational process, immersion into the subject of the study acquired features of individuality and personification, which made it possible to create unique educational subject environments.

With the advent of virtual and augmented reality, immersive technologies are being actively implemented in the education system of Ukraine; these technologies create conditions for complete immersion of students into the learning process and provide an opportunity to overcome educational losses caused by the need to independently process educational information.

Immersive technologies integrate various virtual content technologies with the physical environment, giving the user an opportunity to interact with mixed reality. During this process, the user perceives virtual elements as an integral part of the experience, gradually losing the perception that the objects are not related to physical reality. Immersive technologies include augmented, virtual, and mixed realities [3].

The most widespread application of immersive technologies occurs in the technical, biological, physical, medical and informatics fields of knowledge. The purpose of this work is to determine the specific features of using immersive technologies in secondary education institutions in the process of studying mathematical disciplines.

As noted by V. O. Kolmakova [2], visualization of educational material simplifies its comprehension and is of great importance for quick and effective learning. At the same time, a person remembers 20% of what they see, 40% of what they see and hear, and 70% of what they see, hear and do. It is immersive technologies that make it possible to fully exploit the fact that a person receives 80% of the information from the surrounding world through sight. As a result,

the learner is fully involved in comprehending the learning material, which increases motivation and success in acquiring knowledge and building competences.

Therefore, *immersive technologies for teaching mathematics* are a set of software and hardware tools, methods and ways of organizing effective educational activity among those participating in the learning process with the aim of fully immersing the subject of learning into the learning environment by strengthening the visualization of learning material, interactivity of learning and quality support for the independent work of students.

The advantages of immersive mathematics learning technologies include:

- the ability to visualize difficult-to-understand educational material, for example, stereometric concepts, rules and theorems;
- conducting "personal scientific research" to form mathematical concepts, performing analysis and comparison to obtain new knowledge;
- encouraging students to gain experience in independent work, independent research, enforcing cognitive activity, using a creative approach to solving tasks;
- the possibility to tailor educational material according to the student's own needs;
- facilitating communication between participants, support from other participants, opportunities to discuss educational results;
- observable results of one's own educational activities, the possibility to correct acquired knowledge, analyze errors and develop a positive perception of mathematics;
- an opportunity to build a personal learning trajectory, which is the main component of the blended learning model.

Despite the positive features of immersive technologies, particularly, the possibility of immersion into the subject, which contributes to increasing motivation for learning, concentration and attention, it should be noted that the following can be attributed to negative features:

- high saturation of virtual educational material, which can quickly cause fatigue;
- inability to form the skill of imagining the task, that is, the ability to create images, relying on the program to do it instead;
- lack of skills to perform graphic interpretation of a geometric problem (e.g., a lack of means of constructing geometric figures independently).

According to the interpretation given above, it can be stated that an immersive mathematical environment should consist of well-chosen hardware and software tools of augmented and virtual realities, which, through their correct interaction and the correspondingly selected methodology of their use in the process of studying mathematical disciplines, will influence the subject of education (Fig. 1).

The student's immersive mathematical environment should become part of their personal educational environment and not contradict the basic requirements for the existence of such an environment [4]: multifacetedness, accessibility, identification, interactivity, cooperation, digital communication tools, variability, motivation, adaptability, organization of independent educational and cognitive activities, security and provision of individual comfort, compliance with the culture of informational interaction, freedom of choice of pace, time, place, digital applications, advisory support, self-monitoring, and digital literacy.

Pedagogical interaction between a student and a teacher in an immersive mathematical environment can take place both asynchronously and in the classroom. The asynchronous format of interaction is convenient, provided that the student already understands the essence of mathematical concepts from the studied topic when studying the educational material. In such a format, the use of immersive technologies will only give the student the opportunity to review the less understood questions of the topic and to analyze the educational material more thoroughly. A much more interesting approach is the use of immersive technologies in lessons, that is, in the classroom.

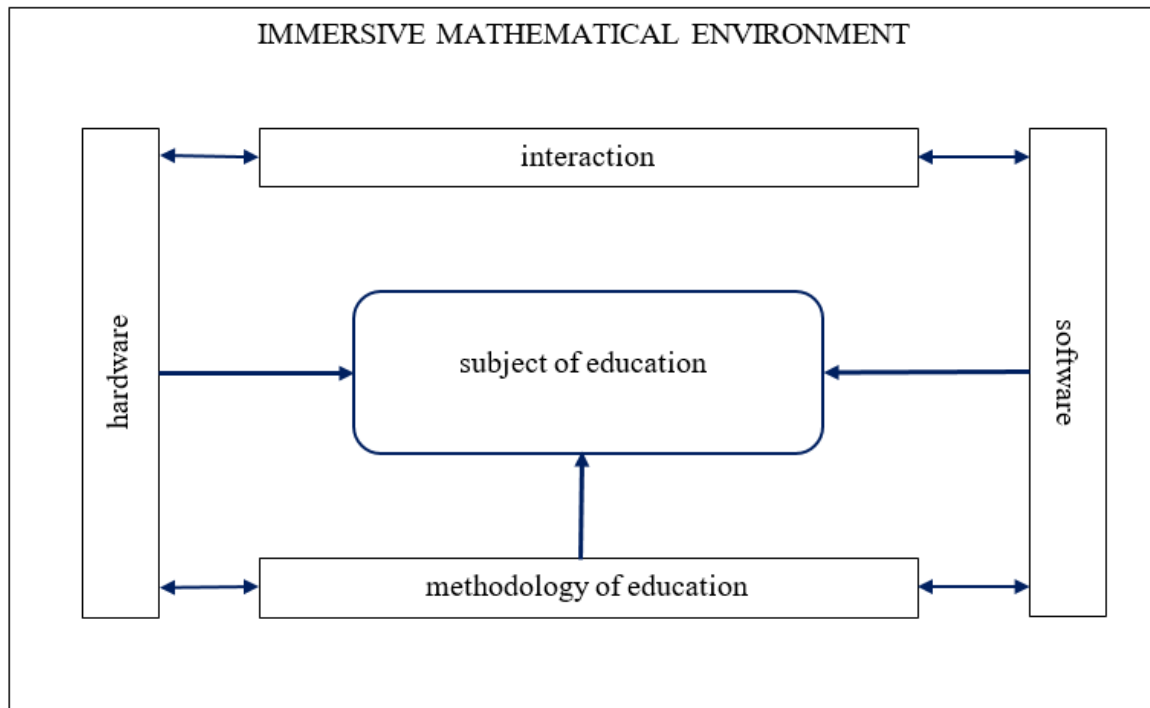


Fig. 1. Immersive mathematical environment

Using these technologies in mathematics lessons under the supervision of the teacher gives students the opportunity to:

- conduct their own research; acquire mathematical concepts through research, which creates conditions for better understanding and memorization of educational material;
- visualize certain spatial geometric objects for a better understanding of their construction on the plane and the solution of the problem;
- use them as expert systems to obtain solutions to algebraic problems for the purpose of self-analysis and searching for errors;
- compare the obtained results with the results of other students and the expected results.

Of course, immersive learning technologies should not become the only source of learning mathematics in secondary education institutions, but a properly organized methodology of teaching mathematics using immersive technologies will expand the opportunities for both students and teachers.

### References

1. Гринчук Л. Інструменти подолання освітніх втрат у шкільній математиці. *Майбуття*. 2023. № 13-16 (708-711). С. 18-19.
2. Колмакова В. О. Імерсивні технології як сучасна освітня стратегія підготовки майбутніх фахівців. *Українські студії в європейському контексті*. № 5. 2022. URL : [http://obrii.org.ua/usec/storage/article/Kolmakova\\_2022\\_177.pdf](http://obrii.org.ua/usec/storage/article/Kolmakova_2022_177.pdf)
3. Малицька І. Д. Імерсивні технології в навчанні природничим наукам: зарубіжний досвід. *Імерсивні технології в освіті*. 2021. С. 110-113.
4. Яремчук Н. Імерсивні технології у професійній дистанційній підготовці вчителів початкової школи. *Неперервна професійна освіта : теорія і практика* (Серія: Педагогічні науки). Випуск № 4 (73). 2023. С. 61-68.