TECHNOLOGIES OF FLIPPED LEARNING IN THE PROFESSIONAL ACTIVITY OF LECTURERS OF HIGHER EDUCATIONAL INSTITUTIONS

TECNOLOGIAS DE APRENDIZAGEM INVERSA NA ATIVIDADE PROFISSIONAL DE PROFESSORES DE INSTITUIÇÕES DE ENSINO SUPERIOR

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ABSTRACT

The article examines the technologies of flipped learning in the professional activities of lecturers of higher educational institutions (HEIs). The relevance of the research topic arises from the fact that the professional development of HEIs' lecturers should be systematic and comprehensive. Accordingly, considerable attention is currently paid to new teaching technologies that can change approaches to the organization of the learning environment. At the same time, it is necessary to pay attention to those technologies that are easy to implement and allow students to be more active. Accordingly, it is advisable to focus on flipped learning technologies. The study aims to investigate flipped learning technologies in the professional activities of HEIs' lecturers on the example of training future mathematics teachers. The research is focused on the learning environment of higher educational institutions. Research methods. The study employed such research methods as description, analysis and synthesis, comparison, generalization, and forecasting. The article examines the technologies of flipped education in the professional activities of HEIs' lecturers. The authors have determined the relevance of new approaches to the training organization. They

revealed the essence of the "flipped learning" concept and its main aspects. The paper also describes the implementation of the flipped learning approach and the changing role of the lecturer. The authors describe the differences between traditional and flipped learning. In particular, they compare the use of information and communication technologies, the role of the student during classes, the educational process, teaching methods, as well as coverage of practical and theoretical issues. It allowed the authors to reveal the main advantages of flipped learning. The article describes the advantages of flipped learning in higher education, including student activation, student interest in the discipline, deepening cooperation between teachers and students, the use of information and communication technologies, and an individual approach to each student. The authors also analyzed the practical experience of A. Kushniruk. In addition, the article considers the technologies of flipped education in the training of future mathematics teachers. Such technologies include video lectures for home study, surveys, discussions, and student projects. Furthermore, the authors determined the conditions for implementing flipped learning into the educational process.

Keywords: A form of work with students, Flipped learning, Future mathematics teacher, Lecturer, Student.

RESUMO

O artigo examina as tecnologias de aprendizagem invertida nas atividades profissionais de docentes de instituições de ensino superior (IES). A relevância do tema de investigação decorre do facto de o desenvolvimento profissional dos docentes das IES dever ser sistemático e abrangente. Assim, atualmente é dada considerável atenção às novas tecnologias de ensino que podem mudar as abordagens à organização do ambiente de aprendizagem. Ao mesmo tempo, é preciso estar atento às tecnologias que são fáceis de implementar e permitem que os alunos sejam mais ativos. Conseqüentemente, é aconselhável focar em tecnologias de aprendizagem invertidas. O estudo tem como objetivo investigar tecnologias de aprendizagem invertida nas atividades profissionais de docentes de IES a partir do exemplo da formação de futuros professores de matemática. A pesquisa está focada no ambiente de aprendizagem das instituições de ensino superior. Métodos de pesquisa. O estudo empregou métodos de pesquisa como descrição, análise e síntese, comparação, generalização e previsão. O artigo examina as tecnologias da educação invertida nas atividades profissionais dos docentes das IES. Os autores determinaram a relevância de novas abordagens para a organização da formação. Eles revelaram a essência do conceito de "aprendizagem invertida" e seus principais aspectos. O artigo também descreve a implementação da abordagem de aprendizagem invertida e a mudança do papel do professor. Os autores descrevem as diferenças entre a aprendizagem tradicional e a invertida. Em particular, comparam a utilização das tecnologias de informação e comunicação, o papel do aluno durante as aulas, o processo educativo, os métodos de ensino, bem como a cobertura de questões práticas e teóricas. Permitiu aos autores revelar as principais vantagens da aprendizagem invertida. O artigo descreve as vantagens da aprendizagem invertida no ensino superior, incluindo a ativação dos alunos, o interesse dos alunos pela disciplina, o aprofundamento da cooperação entre professores e alunos, o uso de tecnologias de informação e comunicação e uma abordagem individual para cada aluno. Os autores também analisaram a experiência prática de A. Kushniruk. Além disso, o artigo considera as tecnologias da educação invertida na formação de futuros professores de matemática. Essas tecnologias incluem videoaulas para estudo em casa, pesquisas, discussões e projetos de alunos. Além disso, os autores determinaram as condições para implementar a aprendizagem invertida no processo educacional.

Palavras-chave: Uma forma de trabalho com alunos, Aprendizagem invertida, Futuro professor de matemática, Conferencista, Estudante.

Introduction

Today, much attention is paid to finding the optimal form of education. For example, it is vital that students are interested and able to interact with each other and develop their skills. This is especially true for future math teachers. They should not only teach students new things but also retain their knowledge. Therefore, the material they present should be clear and understandable.

For this reason, increasing attention is being paid to teaching methods where practice prevails, and theoretical material is considered less. In addition, there must be interaction between the teacher and students. Thus, the learning process should be transformed into a knowledge exchange process. Therefore, flipped learning technologies are gaining more attention.

Literature Review

The issue of flipped learning technologies in the professional activities of lecturers of Higher Education Institutions (HEIs) has been studied by many Ukrainian researchers such as N. Bilousova (2019), D. Vasylieva (2019), D. Voznosimenko (2019), O. Kutnyak (2019), and A. Kushniruk (2019). According to their opinions, flipped learning is currently one of the most effective teaching technologies as it encourages students to engage in the learning process actively.

In particular, in the study by A. Kushniruk, titled "The Application of the Flipped Learning Technology in the Preparation of Future Mathematics Teachers," practical experience in implementing flipped learning into the educational process is presented (Kushniruk, 2019, p. 140). He emphasizes that students consider the active use of the Internet's information space a significant advantage, enabling them to access the necessary information quickly. Additionally, his survey revealed that most future mathematics teachers had a positive attitude toward this technology.

Therefore, the available number of academic research on the studied topic is sufficient for its conduct. All of this attests to the relevance of the issue of flipped learning technologies in the professional activities of lecturers of HEIs.

Research Aims and Goals

The study aims to investigate flipped learning technologies in the professional activities of HEIs' lecturers on the example of training future mathematics teachers. The aim of the study is based on the fact that it is essential to identify those technologies that will allow to carry out educational activities effectively and, at the same time, engage students. Therefore, attention was paid to flipped learning technologies.

According to the aim of the study, the following goals should be achieved:

- to reveal the essence of the concept of "flipped learning;"
- to outline the differences between traditional and flipped learning;
- to describe the benefits of flipped learning in higher education;
- to analyze the technologies of flipped learning on the example of training future mathematics teachers.

Research Methods

The study employed the following research methods: description, analysis and synthesis, comparison, generalization, and modeling. The description method was used to reveal the essence of the "flipped learning" concept. The method of analysis and synthesis was used to display the results of scientific works on the research topic. The method of comparison was used to compare traditional and flipped learning. The method of generalization was used to present the results of the study.

The method of modeling was used to reflect the main technologies of flipped learning that can be used in the training of future mathematics teachers. This method allowed us to determine which technologies are optimal and how they can best be used for teaching.

Results

Today, there is a pressing issue regarding the practical organization of the educational process in which higher education students can actively interact with their instructors while achieving a sufficient level of knowledge. In particular, searching for working methods with students is a process that allows for the best development of future specialists' professional knowledge and skills. For example, business games, role-playing games, and training sessions are currently widespread, all involving students interacting with each other and collaborating with instructors (Ryabukha, 2020, p. 100).

However, the question now also arises about incorporating specific work formats into the learning process and changing the approach to education itself. This is relevant for higher education institutions where students are practically specialists ready to engage in their respective fields. In this context, instructors play a vital role not only as individuals responsible for teaching but also as those who must effectively organize the educational process (Akçayır and Akçayır, 2018, p. 340).

In particular, the issue of the right approach to education at the present stage is especially relevant for future mathematics teachers. This is because students of mathematical faculties must not only acquire knowledge in their discipline but also be able to convey their acquired skills correctly and vividly to their students. Therefore, the organization of educational activities should involve active student participation in the educational process, as well as the establishment of a partnership with the lecturer. The latter should primarily be perceived as an organizer and coordinator rather than just a source of information (Al-Harbi and Alshumaimeri, 2016, p. 76).

Accordingly, it is advisable to use flipped learning technologies to train future mathematics teachers. This will significantly increase the efficiency of the educational process. At the same time, there is currently no single definition of "flipped learning." This is due to the fact that this phenomenon has only recently appeared in the educational process. Flipped learning comes in various forms and

application methods, making it challenging to formulate a single definition. However, in general terms, "flipped learning" can be defined as an "active form of learning that involves the organization of a flipped educational process" (Bilousova, 2019, p. 102). In other words, the conventional educational process is presented in reverse.

The main forms of flipped learning include the following. First and foremost, it involves providing tasks for self-study. At home, students do not complete written or printed assignments; instead, they focus on watching videos related to the upcoming class topic. It means that when the next class begins, the student already understands what the learning material will be about. This allows them to actively engage with the teacher and peers, as they already have some knowledge. Consequently, homework is perceived by students not as something difficult but as a means to understand the upcoming topic better and connect it with previous ones (Bauer-Ramazani et al., 2016, p. 430).

Moreover, these videos are quite illustrative and easy to comprehend. Since they are freely accessible on virtual platforms, students can watch them anytime, making the knowledge acquisition process more accessible. As a result, students are better prepared for the next class, requiring less time to process the theoretical material (Brinks, 2014, p. 5).

During the actual class, students are more focused on solving practical tasks. This allows them to find solutions to the problematic issues that may arise in their professional activities. In addition to acquiring knowledge, students learn how to demonstrate it correctly. For example, in the traditional teaching approach, a future mathematics teacher may only study what algorithms are. At the same time, in flipped learning, little time is devoted to theory, and the primary focus is on solving problems with algorithms and presenting the material to students in an engaging manner. Furthermore, class time is dedicated to project work, emphasizing collaborative efforts among students and partnerships with the teacher (Buitrago and Diaz, 2018, p. 70).

In flipped learning, the delivery of lectures has a unique character. During lecture sessions, students are not merely passive listeners but actively participate

in their presentation. After the material is presented, students and the teacher discuss the main questions that arise after studying the material, engage in discussions, and offer solutions to problems. Video lectures are preferred as they vividly illustrate the problematic issues and present the material in an interactive format. Moreover, during classes, students present their own projects, thereby demonstrating their approaches to relevant issues (Cheng et al., 2019, p. 801).

The role of the teacher also changes during flipped learning. Indeed, they begin to be perceived not as the leader of the educational process but as a coordinator who organizes the learning process and directs students on the right path to acquiring knowledge. Specifically, when providing information, the teacher strives to present students with only a tiny portion of theoretical knowledge and pays more attention to the practical application of the material. It enables student's activation and engagement in the educational process. In particular, students become interested in new material and try to express their thoughts on the problematic issues (Kerr, 2020, p. 2).

Furthermore, during flipped learning, the teacher constantly seeks to vary activities during classes. For instance, at the beginning of the sessions, students, along with the teacher, may discuss topic-related issues. After that, students present their projects, and at the end of the class, students form groups for collaborative games. Therefore, students need to be consistently active and interact with each other, and the teacher should continuously stimulate their greater expression of their abilities (Mercer and Dörnyei, 2020, p. 3).

At the same time, several differences between traditional and flipped learning can be highlighted. They are reflected in Table 1.

In other words, there are significant differences between traditional and flipped learning. All this suggests that the use of flipped learning can effectively change the approach to learning. It should be noted that the implementation of flipped learning is carried out by planning classes, developing electronic presentations and video lectures, and familiarizing students with the new learning format (Blidar, 2017, p. 6).

Table 1 – The difference between traditional and flipped learning

No	Traditional learning	Flipped learning
1	The student is passive and perceives information only according to a certain scheme	The student is active and comprehends the information presented
2	Application of information technologies	Learning with the help of information technology
3	The teacher educates students and supervises the learning process	The teacher gives advice and organizes the learning process
4	Most of the time is devoted to studying theoretical matters	Most of the time is dedicated to practical learning
5	Teaching methods are passive	Teaching methods are active (interactive)

Source: compiled by the authors.

In general, it is possible to identify the following advantages of flipped learning in higher education (Spitz, 2022, p. 150). Figure 1 illustrates such benefits.

Figure 1 – Advantages of flipped learning in higher education
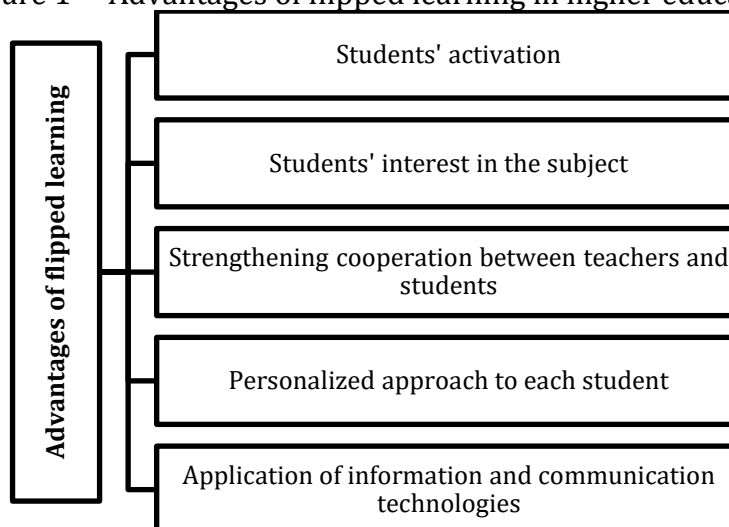
Source: compiled by the authors.

The introduction of flipped learning technology for future mathematics teachers was tested on the practical experience of the researcher A. Kushniruk. In his opinion, given the fact that in order to introduce technology into the educational process of secondary education institutions, future mathematics teachers should be familiarized with its essence, advantages, and disadvantages. They should determine the feasibility of using it in their future professional work. Several classes

were held with students aimed at mastering knowledge of the technology of "flipped learning." In this case, we used precisely this technology. Future teachers were asked to find information on the Internet about the essence of "flipped learning," to write out definitions of the main forms of its application (Podcast, Vodcast from video-on-demand, i.e., video on demand), Pre-Vodcasting, to view chats and blogs of practicing teachers who are implementing this technology today, what difficulties they face, etc. (Kushniruk, 2019, p. 140).

The discussion on the implementation of the "flipped learning" technology in mathematics lessons took place during a lecture discussion titled "Flipped Learning: Pros and Cons." During this discussion, students were asked to answer the following questions:

- Did they understand everything about the "flipped learning" technology?

- Is it necessary to introduce such technology in math lessons, or is it better to stick with traditional teaching methods?

- What advantages did they note regarding this technology?

- What are the drawbacks of this technology?

- Would they consider implementing "flipped learning" in their future professional careers?

- Is it appropriate to use this technology in the process of professional training in higher education institutions?

It's worth noting that the discussion of these questions was quite lively, indicating the interest of most students in the "flipped learning" technology. Some emphasized that since students today prefer spending more time with computers, such technology would be more engaging than simply listening to the teacher. Furthermore, most students have internet access today, which would be fine. Using computers, laptops, netbooks, gadgets, and even mobile phones for studying theoretical material is convenient since it allows students to learn in a place and at a time that suits them. Secondly, this form of learning in schools will contribute to the development of their cognitive abilities and generate interest due to its novelty (Kushniruk, 2019, p. 140).

Moreover, the implementation of flipped learning in the professional activities of higher education instructors for the preparation of future mathematics teachers involves the use of the following technologies. Initially, the instructor records a video lecture containing information about the material that will be covered in the session. This lecture should be concise and include the main theoretical aspects of the session's topic without unnecessary details. For example, if the topic is related to graphing, a video lecture can provide a definition of the concept of "graph," the specifics of its construction, and the application of graphs in practice. All of this should be supplemented with pictures and short video instructions on how to create graphs (Vasylieva, 2019, p. 60).

The next step is to send the video lecture to students. This can be done either in a specific chat room of an academic group on social media, by e-mail, or on the group's website in a virtual platform. Using these tools will allow students to have equal access to video lectures so they can watch them at their own convenience. At the same time, this will make it impossible to send a video lecture to a responsible person from the group, who may not send it to everyone or may also lose access to the video lecture (Van Alten et al., 2019, p. 14).

We can also distinguish the next stage, which uses the flipped learning technology during the independent study of the class topic. Thus, after watching the lecture, the students should identify their questions about the material. In doing so, they can complete a simple task, such as an online test, reflecting their knowledge of the video lecture. If the test shows an insufficient result, the students can watch the video lecture again, which will allow them to identify difficult questions on the topic. At the same time, it is advisable to make tests small in size, which will make students interested in studying the materials (Voss and Kostka, 2019).

Also, tests should contain both textual and graphic questions. For example, a textual question asks which solution to a problem is correct, with the condition of the problem. Graphic questions include an image of a graph or geometric figure with a question below the figure. Accordingly, the presentation of an image allows you to present the material visually and simplifies its comprehension. Thus, if the condition

of the task is to find the angles, then the triangle image allows you to identify which angles are already known (Kutnyak, 2019, p. 48).

The technology of flipped learning in the classroom involves the active involvement of students in the learning process. For example, at the beginning of the class, students can read out a prepared list of questions that have arisen after watching a video lecture. However, it is possible to involve the teacher and other students in answering them. For example, a student can read out a problematic question. If another student knows the answer to it, he or she answers. If not, the teacher responds. This allows to stimulate students to interact with each other to solve complex issues (Voznosimenko, 2019, p. 68).

Students can also propose a discussion question. In particular, it can be based on a problematic issue and can be connected to video lectures. For example, students can read out the condition of a problem with different solutions. After listening to the problem, the teacher can indicate the option that they like the most and be interested in the opinion of students who can identify another option. This will make the discussion interesting and lively, and the students who asked the question are the most important in such a discussion because they should control the discussion process. The teacher should choose the best option but explain it.

At the same time, students' projects can be considered in class. For example, if the topic concerns modern forms of information presentation, the teacher can ask students to choose a specific platform for solving math problems or building graphs. The student should be able to explain their choice, talk about the platform, and show how to perform exercises. At the same time, the student can invite others to try using the program, including the teacher (Sadkina, 2018, p. 14).

The teacher can also invite students to take a survey. It should include basic information about the class and students' opinions on how the material is presented. Such a survey can also be conducted during lessons, as well as online, and can contain simple tasks that students can use to gain practical experience (Låg and Sæle, 2019, p. 50).

In addition, in the classroom, the teacher should pay considerable attention to the use of innovative and communicative technologies in practical experience.

This may include the use of special programs for calculating or graphing functions, applications for working with formulas, and platforms for solving algorithms. At the same time, the teacher should use electronic formats for showing the practical part, such as videos and presentations, for a significant part of the class. In particular, it can show different videos taken from YouTube or other social networks on how to solve a particular equation or graph functions, so the teacher can offer students to compare different approaches (Prykhodkina, 2014, p. 141).

At the same time, the implementation of flipped learning requires compliance with the following requirements. First of all, it is to provide students with the opportunity to access the materials of the next topic at home. In this way, students actually study at home because they do not repeat the class material but learn new ones. They also have more resources and time at home to work on complex issues, and using electronic means of access to information is only an advantage (Turan and Akdag-Cimen, 2019, p. 43).

In the classroom, the teacher should explain the topic briefly and focus on something other than the theoretical part. The lesson should focus more on the practical part, mainly on how the acquired knowledge can be used in professional activities. This will prepare future teachers for various problematic situations while working as mathematics teachers (Egbert et al., 2014, p. 6).

At the same time, the teacher should allow students to use various materials printed out or written out at home, as well as information posted in the virtual space during classes. For example, the teacher may ask students to find specific information, thereby testing their knowledge of using special professional programs and the Internet. The teacher can also encourage students to search for information on social networks to know how to use different resources (Sams, 2014, p. 1).

According to this, the teacher should encourage the use of electronic textbooks. This will allow you to conveniently work on the lesson's topic without searching for additional information, as electronic textbooks may contain hyperlinks to specific material. Another advantage of e-textbooks is the availability of videos that explain the topic of the lesson, which allows you to present the material visually (Setren et al., 2019, p. 4).

A great deal of attention should be paid to projects. For example, students working on a particular idea should learn to justify its importance adequately and find different solutions to problematic issues. All this suggests that students should be able to present their approach to a particular case, and the teacher should encourage them to do so. In addition, attention is paid to information and communication technologies, which are actively used during project defense (Bulvinska, 2019, p. 90).

The importance of a separate information space for teachers and students can also be noted. For example, a special room should be created using virtual platforms or social media to house all materials related to the discipline. This includes a list of topics and questions for study, video lectures with educational material, various information materials, and links to special services. Such a space will allow students to find the information they need faster. Besides, it will enable the teacher to create a complete educational and training base for their discipline.

Discussion

The conducted research contained certain controversial aspects. First and foremost, flipped learning requires the display of the lesson topic through video lectures. However, not all teachers have the technical capabilities to record video and send it to students. Also, not all teachers can deliver a lecture in a video format because not everyone can hold a camera and read a text for a long time. Therefore, all teachers who work with this technology must take courses on working with information and communication technologies.

The next aspect is that flipped learning is focused on teaching how to solve practical problems. Accordingly, during such training, the focus should be on problem-solving. However, it can be noted that when dealing with complex topics, it would be possible to focus on theory, as it is necessary to identify the main aspects of the learning problem.

Conclusions

As a result of the study, the following conclusions were drawn. First of all, we have revealed the essence of the concept of "flipped learning." Flipped learning can be defined as an active form of learning that consists of organizing a flipped learning process. In other words, the main theoretical issues are studied at home and discussed in class.

The article characterizes the differences between traditional and flipped learning. Some of the differences between traditional and flipped learning include:

- the use of information and communication technologies,
- the role of the student in the classroom,
- the learning process, teaching methods, and coverage of practical and theoretical issues.

At the same time, there is not always a clear line between these aspects due to the peculiarities of the educational process.

Finally, we described the advantages of flipped learning in higher education. The following are the advantages of flipped learning in higher education:

- Students' activation.
- Students' interest in the discipline.
- Deepening cooperation between the teacher and students.
- The use of information and communication technologies.
- A personal approach to each student.
- All of them have a positive impact on the level of students' knowledge.
- The article analyzed flipped learning technologies on the example of training future mathematics teachers. Flipped learning technologies are manifested in such forms of work as video lectures for home study, surveys, discussions, and student projects. However, their implementation is a challenging process.

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