Organization of Adaptive Training Using Artificial Intelligence Technologies in the Context of War

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Abstract— **Digital transformation of spheres of human life involves the development and implementation of artificial intelligence technologies, particularly in the educational system. The article covers the potential of organising adaptive learning in the context of the war in Ukraine. It determines the theoretical foundation, defines the essence of artificial intelligence technologies, and presents their classification and areas of application. It determines the advantages of using artificial intelligence technologies in the organisation of the educational process of a higher education institution. The platforms and specialised software using artificial intelligence technologies that ensure the organisation of adaptive learning are characterised. It is noted that the most optimal platform for the use of artificial intelligence, particularly chat-bots, is Telegram, which creates not only a platform for communication and posting diverse information, but also serves as a means of organising an individual educational trajectory and allows one to upload files and exchange educational content. JavaScript language is used for implementing Telegram educational chat-bot's multi-functionality. The article theoretically grounds and presents the algorithm for the application of artificial intelligence, in particular, a chat-bot, in the conditions in the context of adaptive learning in the pedagogical institution of higher education. It highlights the features of using chat bot for studying the discipline "Engineering and Computer Graphics". The chat-bot is implemented on the Node.JS platform, using the Node-Telegram-Bot-API library. The results of a pedagogical experiment are presented, which included a survey on the effectiveness of using artificial intelligence, in particular Telegram, to organize adaptive learning among students and teachers. The results of the survey among students showed that the use of telegrambot is appropriate in the process of professional training, as it provides quick access to various types of information through the integration of web applications, intelligent systems and access to intelligent artificial intelligence systems. Teachers noted that in the process of using telegrambots, direct contact with students decreased, they noted that the chatbot's reaction was not always correct, low Internet connection speed, insufficient digital skills of teachers to create adaptive digital environments, IT security problems, and uncertainty in using modern digital standards. A comparison of the survey data of students and teachers shows that telegrambots are in demand among students and require the development of digital skills of teachers in creating and implementing adaptive digital environments using artificial intelligence technologies.**

Keywords— adaptive learning, artificial intelligence technologies, educational chat-bot, students of the pedagogical university.

I. INTRODUCTION

The development of technologies and the pace of their spread affect all spheres of human life. The educational environment is not an exception, as the digital space contributes to the globalization of science and education. According to the analytical company International Data Corporation (IDC), the amount of information is growing exponentially and by 2025 its volume will have increased

10 times in comparison with 2016, and will exceed 163 zettabytes [1]. This is the result of the ability of computer systems to process information at high speed.

The introduction of electronic educational resources and information and communication technologies into the education system is due to the need for successful integration into the global educational space, increasing the competitiveness of higher education institutions at the international level, and the formation of a new paradigmatic status of the educational institution. The demand for using the potential of digital technologies, in particular artificial intelligence methods, is reflected in the emergence of numerous online courses, visual control programs, and distance learning. This has become vitally necessary in Ukraine in the context of the COVID -19 pandemic and full-scale war.

Considering the requirements of the modern educational space, the education system requires the organization of adaptive learning using adaptive digital environments that are able to meet the interests and needs of the participants in the educational process. The importance of adaptive learning, as the coronavirus epidemic and the war in Ukraine have shown, is beyond doubt, as its role is recognized by the vast majority of both scholars and educators.

II. Materials And Methods

The purpose of our research is to determine the features of the organization of adaptive training using artificial intelligence technologies in the context of war.

To achieve the research goal, a set of theoretical and empirical methods. Theoretical methods. was applied: theoretical methods - analysis, systematization, generalization of the works of domestic and foreign researchers, experts, own pedagogical experience and the experience of the project team Transformation of the Teacher Digital Competence Formation System : Innovative European Approaches (Project: 101085799 – TSDigComp – ERASMUS-JMO-2022-HEI-TCH-RSCH (Grant Agreement No. 101085799 – TSDigComp) regarding creation and use of an adaptive digital environment for those seeking education in war conditions and determining the content of adaptive learning models using digital technologies, in particular artificial intelligence; identification of factors that determine the effectiveness of an adaptive digital environment, in particular a chatbot. Empirical methods: questionnaires and interviews with the students of specialty 015.39 Vocational education (Digital technologies), project participants Transformation of the Teacher Digital Competence Formation System : Innovative European Approaches and teachers of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University regarding the effectiveness of using an adaptive digital environment, in particular, Telegram in the process of studying the academic discipline "Engineering and Computer Graphics" and within the framework of the project implementation Transformation of the Teacher Digital

Competence Formation System : Innovative European Approaches.

Surveys and interviews were conducted in September 2024.

III. Results And Discussion

In modern research, scientists describe adaptive learning as a technology and as a process.For example, P. Kerr described adaptive learning as an educational technology, the purpose of which is to create "automated, dynamic and interactive content" [2] . J.M. Lowendal and colleagues defined adaptive learning as a process that "... dynamically adjusts the way educational content is presented to learners based on their responses to proposed tasks or based on their preferences (for example, visual presentation of content)" [3]. Scientists emphasize that adaptive learning contributes to obtaining a unique learning experience taking into account the individual characteristics of students, improves the learning process, and contributes to the formation of professional competencies of future specialists.

The analysis of scientific studies [4]–[6] made it possible to **conclude** that there are differences in the focus of adaptive learning analysis. Researchers consider it appropriate to take into account the following characteristics of students when developing an adaptive system:

- basic knowledge and fundamental knowledge in the discipline being studied;
- cognitive styles, or thinking styles, which are ways of engaging in cognitive activity;
- learning styles – habitual approaches based on the individual characteristics of studentst;
- metacognitive knowledge – awareness of personal cognitive processes in relation to the capabilities of others;
- student preferences;
- student behaviour (e.g., viewing videos, answering test tasks, etc.);
- student profile - personal data of the student (gender, age, etc.);
- student abilities – psychological traits that determine success in the learning process (acquired knowledge, developed abilities, skills);
- student interests – the motivation to learn something new [7], [8].

One of the trends in modern didactics is the development of adaptive educational technologies for teaching various disciplines.

In 2021, the Concept of the Development of Artificial Intelligence in Ukraine until 2030 was approved. The document states the need for "...implementation of artificial intelligence technologies in the field of education, economy, public administration, cyber security , defense and other areas to ensure Ukraine's long-term competitiveness in the international market." [9] In 2022,

during the war, in the context of the Recovery Plan of Ukraine, the "Education 4.0: Ukrainian Dawn" programme was presented, which is a concept of education that involves the use of the latest technologies to improve the educational process and prepare students for life in a digital society and is based on the principles of flexibility, customization, collaboration and advanced learning. The purpose of education 4.0 is not only to prepare students for the digital economy and robotization of labor, but also to prepare citizens for life in the modern world who can think critically and creatively, develop life and professional self-improvement skills.

Scientists identify three main models of adaptive learning: the student model, the content model, and the learning model. A student model is the provision of information about an individual student that is necessary for an adaptive system. The model includes information provided directly by students (for example, personal data), information about academic performance, topics of the discipline that the student has already studied, watching videos, studying additional materials, etc. The system uses this information to predict the behavior of the student and adapt it to his or her individual needs [8].

Methods of adaptation of learning material based on the student model are quite popular, as it is believed that an adaptive system can be effective only if it is able to adapt to the needs of students [10].

The content model is based on its characteristics and searche for relevant learning resources that meet the needs and preferences of users [8].

A learning model, also known as a pedagogical model, helps adapt the educational process based on the learner's model and provides a basis for making decisions about what content to provide to the student (taking into account speed, format, sequencing of materials, etc.).

The popularization of modern adaptive learning and the implementation of the suggested adaptive learning models is connected with the development of digital technologies, in particular with artificial intelligence. It is one of the important tools that provides access to various educational resources, promotes individualization \ training.

Therefore, the organization of adaptive learning requires the development of modern digital environments using artificial intelligence. In our study, we will consider an adaptive digital environment as a system that basically uses algorithms with elements of artificial intelligence and machine learning to implement adaptive learning models, taking into account the needs of the student, the features of the content and the learning model.

Analysis of literature [11] – [14] allowed us to classify technologies and practices of using AI in education and identify their main characteristics (*table*)

In our research, we consider chatbots to be one of the ways to organize adaptive learning using artificial intelligence. From the point of view of modern scientific realities, the work of a teacher and a student is compared to the personalization of learning, which is based on the creation of electronic courses, considering the individual characteristics of students, in particular their psychological characteristics, the level of initial knowledge, individual goals and educational tasks. Compared to classic digital environments, the chatbot offers the following features: reduced workload, shorther learning time due to a carefully selected information block; increased target audience as a result of attracting students with different levels of training; saving traffic during online education, using effective control tools, etc.

TABLE 1 PLATFORM NAME AND CHARACTERISTICS OF TECHNOLOGIES AND PRACTICES OF AI APPLICATION IN THE FIELD OF EDUCATION

Technologies and practices	Characteristics
Language technologies recognition, processing and generation of human speech	The computer recognizes speech and processes it. It can present the identified patterns and results of the analysis with the help of speech that is accessible for perception
Technologies for personalisation learning, adaptive training	Features of artificial neural networks are considered. They find regularities in masses of information and use them to project individual educational trajectories. Training is adjusted to the level, individual characteristics and goals of the students
Virtual assistants	Use information from the Internet, as well as information selected by the user, for forecasting purposes, for example, predicting an individual study schedule
Proctoring	Used to identify students during distance learning (for example, during an exam), tracks redundant and atypical elements (people, sounds), opening new tabs, eye movements, etc.
Interval technologies (intermediate) education	The app tracks the learning material studied, the periods of learning interruptions. Based on the information, it predicts which sections the students have not mastered sufficiently. Then they are recommended for revision
Automatic assessment	A specialized computer program based on AI that simulates the behavior of a teacher who assigns grades. It can evaluate and analyze the learning outcomes of education seekers
Smart campus	A type of chatbot for answering typical students' questions. For example, the schedule of classes, availability of places in dormitories, location of classrooms, availability of educational content, etc
Gamification	Application of computer games and simulators in education
Chatbots	The program simulates a live conversation with the user.

In the process of adaptive learning, chatbots do not require the direct participation of the teacher, because they are based on the interaction of education seekers and the adaptive digital environment.

A pedagogical experiment was conducted to obtain experimental data in the process of designing and creating

an adaptive digital environment, in particular a telegram bot for the implementation of adaptive learning models taking into account the needs of students, content and learning model. In the process of studying the disciplines of the professional cycle for students of the specialty 015.39 Vocational education (Digital technologies) and project participants Transformation of the Teacher Digital Competence Formation System : Innovative European Approaches (Project: 101085799 – TSDigComp – ERASMUS-JMO-2022-HEI-TCH-RSCH at Vinnytsia State Pedagogical University named after Mykhailo Kotsiubynskyi, a survey was conducted regarding the organization of adaptive learning using Telegram . The survey was anonymous, the sample of respondents is not representative. Coverage of respondents – 52. Questionnaire questions related to the effectiveness of using artificial intelligence, in particular Telegram in the conditions of implementation of adaptive learning models meet the needs of students.

The development, implementation and use of AI products and programs in the educational space of Ukraine has significantly increased and accelerated in the conditions of the coronavirus and war. For some time, the educational process was completely transferred to a distance format, and this could not be done without achievements in the IT sphere. We would like to note that since February 2023, GPT chat has become free in Ukraine.

In the conditions of the coronavirus, UNESCO experts developed a universal classification of tools for the organization of distance learning with the use of AI, namely: digital resources for psychosocial support of all subjects of the educational process; digital learning management system (Google Classroom, Moodle, Blackboard , Canvas , etc.); educational programs for mobile gadgets; open online courses; services for self-study; digital readers (books); programs for the joint work of all participants of the educational process online (Telegram, Skype, Zoom, WebEx , etc.); tools for creating digital educational content.

The question remains whether students can improve their results when the educational system is adapted to their needs. According to P. Johannes and A. Lagerstorm [15], this issue can be best addressed by the joint efforts of scientists , educators and developers of adaptive digital environments.

Based on the data of "AIN.UA" - a Ukrainian online publication about IT business, startups, technologies and entrepreneurship. The mass media covers everything that happens in the Ukrainian Internet: deals and startup launches, success and failure stories, journalistic investigations and author's columns are published (Fig. 1).

Therefore, in our research, we will present an algorithm for creating an adaptive digital environment, in particular, a Telegram bot into which Google is integrated Classroom API and artificial intelligence system.
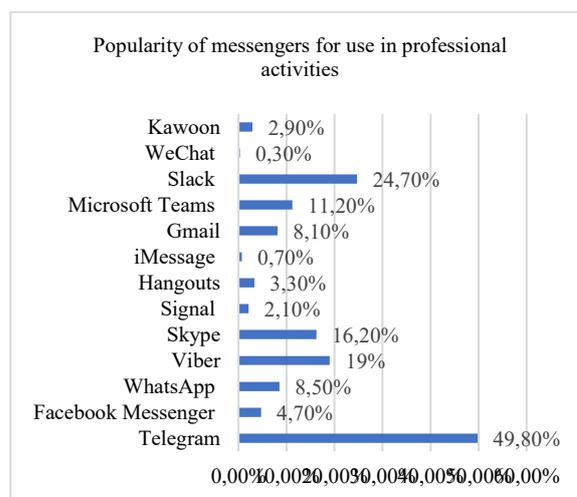

Fig. 1 Diagram showing the popularity of messengers for professional use

Telegram is an open-source cross-platform messenger with IP telephony features that allows you to exchange text, voice and video messages, photos and files in many formats. As of March 2021, official clients for Telegram include:

- Mobile applications for Android and iOS / iPadOS;
- Desktop applications for Windows, Linux and macOS;
- Web application.

Using the Telegram messenger, users get not only a platform for communication, but also many other features, thanks to which the messenger has gained great popularityю

Creating a Telegram bot using node js , node-js-telegram-api, and nest js is a difficult but rewarding task. A Telegram bot is a program that can interact with the users through the popular Telegram messaging platform. Node js is a JavaScript runtime that allows developers to build scalable and efficient web applications. Node-js-telegram-api is a library that simplifies communication between node js and Telegram Bot API. Nest js is a framework that provides a modular and flexible architecture for building node applications.

Here are the stages of the telegram bot creation algorithm:

1.   Register a new bot in Telegram using the BotFather service. This will provide us a unique token that can be used to authenticate our bot and access the Telegram Bot API .

2.   Create a new JavaScript project and install the necessary dependencies, such as node-js-telegram-api and nest js .

3.   Create the main module that will load our nest application js and initialise our Telegram bot. We can use the Telegram bot class from node-js-telegram-api to instantiate our bot and pass it the token we received from

BotFather . Next, we set up some event listeners to handle the different types of messages and commands that our telegram bot will receive from the users.

4.   Create a service module that will contain the business logic for Telegram. This module defines the methods that the Telegram bot will use to perform various tasks such as sending messages, receiving data, processing commands, etc.

5.   Create a controller module that will manage the Telegram bot's routes. This module defines the endpoints that the Telegrambot uses to communicate with the Telegram Bot API. Decorators from NestJS are useful for mapping these endpoints to methods from the service module. At this stage, we use middleware functions to inspect and analyze incoming requests from Telegram (Fig. 2).

```
    const access_token = await
this.authService.getAuth({
    telegram_id: +body.telegram_id,
    });const classroom = google.classroom({
    version: 'v1',
    });
    const course = await
classroom.courses.courseWork.get({
    access_token,
    courseId: '596489149759',
    id: body.id,
    });
    console.log(course.data);
    return course.data;
    }
}
```

Fig. 2. View of the telegram bot for training for the students majoring in 015.39 Vocational Education (Digital Technologies)

Considering the practical experience of the teachers of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, the Google Classroom learning management system is quite common in wartime, which organizes the educational process in distance learning.

However, in times of war, access to the Internet faces significant problems. The students are not always able to visit Google Classroom and complete the assigned tasks in time. In uch circumstances , the telegrambot we have created saves traffic due to the absence of a redundant graphic interface. A comfortable work speed for the participants of the educational process can be achieved even with a lower speed of the Internet connection.

The telegrambot we have created allows us to integrate Google Classroom in some academic disciplines in the context of the organization of adaptive training for the students of Vinnytsia Mykhailo Kotsyubynskyi State Pedagogical University. This approach will allow you to synchronize with the educational process, adapt to the progress of the participants of the educational process, independently adjust and study the educational content in real time.

To integrate Google Classroom in the Telegram bot, we need to use Google Classroom API, which is a RESTful web service that allows developers to manage courses, assignments, students, teachers, and other

resources on Google Classroom.

Here is the algorithm for integrating Google Classroom into a Telegram bot :

1.   Activate the Google API Classroom in our Google project Cloud Platform and get the API key and client ID. We also need to set up the OAuth 2.0 consent screen and configure the areas that Telegram bots will ask the users when they allow it to access their Google Classroom data .

2.   Create a new service module that will handle communication between Telegrambot and the Google API Classroom . This module will define the methods that the Telegrambot will use to perform various tasks, such as creating courses, to-do lists, grading submissions, and more. The googleapis or axios libraries are useful for making HTTP requests to the Google API Classroom .

3.   Change the main module and add logic for OAuth 2.0 flow processing. To do this, we need to create an authorization URL that redirects users to a Google login page where they can give Telegrambot permission to access their Google data Classroom .

4.   Create an endpoint that will receive an authorization code from Google and exchange it for access tokens and updates. The passport or oauth2orize libraries are useful at this stage to simplify this process.

5.   Modify the controller module, add some commands and messages that will allow users to interact with Google Classroom via Telegram .

6.   Create the classroom command that will offer users to authorize the telegram bot . If they haven't already done it, it will then display a menu of options to manage their courses and assignments. In this case, create messages that notify users of new assignments, submissions, grades, etc. (Fig. 3).

```
    const access_token = await
this.authService.getAuth({
    telegram_id: +body.telegram_id,
    });
    const classroom = google.classroom({
    version: 'v1',
    });
    const course = await
classroom.courses.courseWork.get({
    access_token,
    courseId: '596489149759',
    id: body.id,
    });
    console.log(course.data);
    return course.data;
    }
}
```

Fig. 3 Access to Google in Telegram Classroom from the academic discipline "Engineering and Computer Graphics"

In order to integrate artificial intelligence systems into Telegrambot , we need to use certain machine learning or natural language processing techniques that will improve the functionality and operation of Telegrambot .

We will offer possible scenarios for the integration of

artificial intelligence systems:

- Use natural language understanding (NLU) to analyze user input and extract intent and essence from it. This will allow us to understand what the user wants. For this, the dialogflow or wit.ai libraries are useful , which allow you to create an NLU model for the telegrambot and train it with sample utterances and intentions.
- Use natural language generation (NLG) to generate natural and engaging responses for our users. This will allow us to personalize their messages and make them more conversational. The gpt-3 or openai-api libraries are useful , providing text generation based on specific input or context.
- Use machine learning to analyze user feedback and behavior to further adapt Telegram to the learners' needs. In this case, the tensorflow or pytorch libraries are useful for building a machine learning model in telegrambot and training with data and metrics (Fig. 4).

```
        const access_token = await
this.authService.getAuth({
        telegram_id: +body.telegram_id,
    });
        const classroom = google.classroom({
        version: 'v1',
    });
        const course = await
classroom.courses.courseWork.get({
        access_token,
        courseId: '596489149759',
        id: body.id,
    });
    console.log(course.data);
    return course.data;
    }
```

Fig. 4. Telegram bot access to the Open artificial intelligence system Chat - GPT AI Bot v3.0.2 in the process of studying the educational discipline "Engineering and Computer Graphics"

It should be noted that we have tested Telegrambot , which integrates Google Classroom API and artificial intelligence system in the process of studying the educational discipline "Engineering and Computer Graphics" of the specialty 015.39 Professional education (Digital technologies) and project participants Transformation of the Teacher Digital Competence Formation System : Innovative European Approaches (Project: 101085799 – TSDigComp – ERASMUS-JMO - 2022-HEI-TCH-RSCH at Mykhailo Kotsiubynskyi Vinnytsia State Pedagogical University.

As part of these activities, a pedagogical experiment was conducted, which included a survey on the effectivenes of using artificial intelligence, in particular, Telegram for the organization of adaptive training of the students.

The analysis of the results of the questionnaire during the pedagogical experiment made it possible to highlight the possibilities that indicate the appropriateness of using Telegram for the organization of adaptive learning: saving time for studying the discipline - 8%, correctness of the material - 6%, instant communication - 10%, accessibility of learning - 5%, simple interface - 7%, ease of use - 15%, integration of web applications and intelligent systems - 21%, access to intelligent artificial intelligence systems - 25%, difficulty in use - 2%, lack of gadgets - 0%, limited access to the Internet - 1 % (Fig. 5).
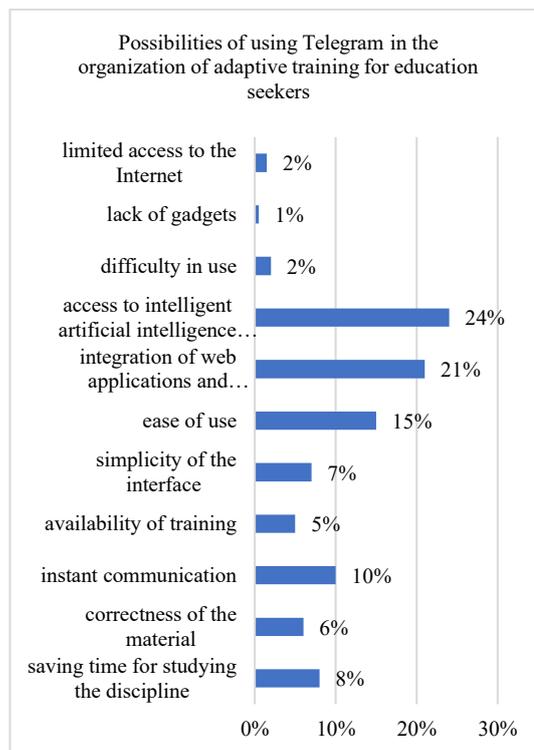

Fig. 5. A diagram demonstrating the possibilities of using Telegram in the organization of adaptive training for students

The results of the survey among the students showed that the use of telegrambot is appropriate in the process of professional training of students, as it provides quick access to various types of information through the integration of web applications , intelligent systems and access to intelligent systems of artificial intelligence. Under such conditions, artificial intelligence technologies, in particular, telegrambot, can increase the accessibility of education and contribute to the improvement of the quality of professional training of the students.

The opinion of the teachers of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University is important regarding the creation and implementation of adaptive digital environments using artificial intelligence technologies, in particular telegrambots . As part of the study, a survey of teachers was conducted in order to determine the features of using adaptive digital environments, in particular telegrambots in the organization of adaptive learning (Fig. 6).
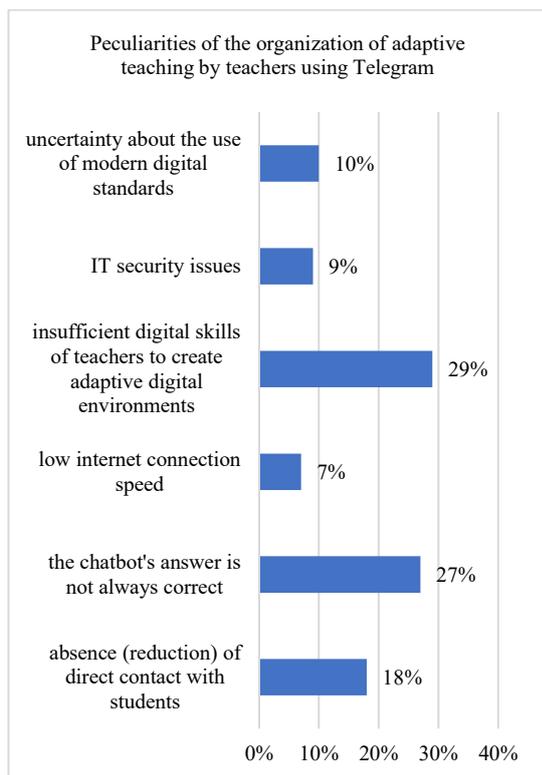
Fig. 6 Diagram showing the peculiarities of the organization of adaptive learning by teachers using Telegrambot

The teachers' survey allowed us to identify the specifics of using of artificial intelligence technologies, in particular telegrambots , and to obtain the following data: lack (reduction) of direct contact with students - 18%, not always correct response of the chatbot - 27%, low speed of Internet connection - 7%, insufficient digital skills of teachers to create adaptive digital environments - 29%, IT security issues - 9%, uncertainty about the use of modern digital standards - 10%.

A comparison of survey data from students and teachers regarding the use of artificial intelligence technologies, in particular telegrambots , for the organization of adaptive learning shows that telegrambots are in demand among the students and require the development of digital skills of teachers regarding the creation and implementation of adaptive digital environments using artificial intelligence technologies, in particular telegram bots.

IV. CONCLUSIONS

The implementation of adaptive digital environments using artificial intelligence technologies is rapidly developing and requires a constant search for innovative approaches to their creation and use in the process of professional training of students. The implementation of adaptive digital environments using artificial intelligence technologies, in particular telegrambots , ensure flexibility, openness to modifications, accessibility in the conditions of the organization of adaptive learning through

individualization, personalization, a person-oriented approach to learning. The analysis of scientific sources allowed us to generalize that Telegram not only creates a platform for communication and allows you to post diverse information, but is also a means of organizing an individual learning trajectory, allows you to upload files and exchange educational content.

The results of the pedagogical experiment proved that for students, using telegrambot is appropriate in the process of professional training, as it provides quick access to various types of information through the integration of web applications, intelligent systems and access to intelligent artificial intelligence systems. Teachers noted that in the process of using telegram bots, direct contact with students decreased, they noted that the chat bot's reaction was not always correct, the low speed of the Internet connection, insufficient digital skills of teachers to create adaptive digital environments, IT security problems, and uncertainty in the use of modern digital standards.

A comparison of survey data from students and teachers shows that Telegram bots are in demand among students and require the development of teachers' digital skills in creating and implementing adaptive digital environments using artificial intelligence technologies.

Given this, we consider it relevant and promising to study the theoretical foundations of design, the creation of adaptive digital environments using artificial intelligence technologies, in particular telegrambots based on web technologies , as well as the development of methods for their use in the professional training of education seekers, in particular in war conditions . Since adaptive digital environments based on artificial intelligence technologies, in particular, telegrambots will become a driving force for the development of digital pedagogy to expand the possibilities of active learning.

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