European Journal of Contemporary Education
E-ISSN 2305-6746
2023. 12(2): 578-589
DOI: 10.13187/ejced.2023.2.578
https://ejce.cherkasgu.press

Using Artificial Intelligence Tools in Teaching a Foreign Language in Higher Technical Institutions

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Abstract

Technological developments that take place nowadays and the accompanying process of digitalization in every area entail serious challenges for the whole society and for the system of education as its integral part. As a result, the teaching process nowadays, including foreign language teaching, involves using a wide range of technical and technological facilities. This paper analyses the possibilities of using digital intelligent technologies in university academic process with the focus on teaching a foreign language to students of higher education institutions specialising in the technical field. The work gives a review of existing online study courses, educational platforms, and artificial intelligence (AI) technologies. The key features of several intelligent applications that are in common use are also outlined. The paper presents a description of a pedagogical experiment carried out in a technical university and aimed at estimating the effectiveness of integration of digital tools into the teaching and learning process. The outcomes of the experiment are evidence that using digital technologies enhances the learning activity and motivation of the students, with a positive impact on their lexical skills and overall performance, which as a result leads to achieving the ultimate goal of language learning, the communicative competence. The article also offers specific recommendations on the choice of electronic educational resources and outlines a number of problems encountered while using digital software.

Keywords: digital technologies, foreign language learning, artificial intelligence, mobile applications, educational platforms.

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1. Introduction

In recent years numerous works have been published on the use of artificial intelligence (Zakharov et al., 2022), neural network technologies (Ignatiev i dr., 2019; Zemenkova et al., 2022), and the introduction of machine learning in various industries (Filippov et al., 2022) as well as in education (Amemado, 2020; Chen, et al., 2020; Larimore, 2020) and, in particular, in teaching a foreign language language to students of a technical university (Pikhart, 2020; Schmidt, Strasse, 2022; Varlakova et al., 2023). Teaching a foreign language is now associated with the use of various technical facilities, such as language laboratories, training programs, electronic dictionaries, audio and video courses. Advances in technology and the accompanying digitalization in the 21ST century imply significant challenges both for society as a whole and for educational system. The provision of broadband access to the Internet allows for use of distance technologies and adapting education to individual learner's needs. The article aims to analyze the use of digital intelligent technologies in teaching a foreign language to students of a technical university, as well as to consider the effectiveness of using digital technologies in foreign language teaching (Pikhart, 2020).

In the Russian Federation, the strategy for development of artificial intelligence (AI) for the period up to the year 2030 was approved by the Presidential Decree № 490 (Decree of the President, 2019) as of October 10, 2019. Since September 1, 2021 the relevant strategies have been introduced in the curricula of Russian universities. Digital competences now included in the Federal State Educational Standards of Higher Education for the Bachelor and Specialist degrees are aimed at implementing the key priorities of the Digital Economy of the Russian Federation national programme (Pasport natsional'nogo proekta...; Shestakova, Morgunov, 2023). The use of Big Data technology in combination with sophisticated analytical processes (learning analytics) opens the prospect for personalised education that has a direct bearing on blended learning (Owoc et al., 2021).

Today, over 400 Russian companies are active in developing and use of artificial intelligence. An alliance of IT companies has been established, with the participants making it their ultimate goal to place Russia in the top ten of countries with most advanced digital technologies.

As a rule, intellectual technologies are supported by the e-learning environment existing in a specific educational institution. The task performed by such environment is to form a learners' digital footprint by gradually accumulating a variety of data and storing the reported database that contains the data on their performance and assessment indicators (Kovalenko i dr., 2021). Internet services and educational platforms provide a wide range of tools for designing learning content and management of learning (Gerasimova et al., 2022; Koltsova, Kartashkova, 2022; Pivkina, Nikonova, 2022; Pivkina, Nikonova, 2022). Another fact that should be taken into account is that along with the e-learning environment, educational institutions normally use electronic tools for management of learning (LMS), accounting (1C), and for personnel management (ERP, e-HRM). In this connection, algorithms must be developed to synchronize their data and processes.

With this in mind, the purpose of this work is to consider possibilities of designing and using elements of e-learning environment in teaching foreign languages at a technical university. The work analyses the effectiveness of desktop and smartphone applications use for the learning process. It also gives an outline of special aspects of using intelligent applications in foreign language classes, of the possibility of using AI to create an adaptive learning environment, and of common digital learning platforms. The work provides direction for work with electronic educational resources and outlines the questions of software development and use. Therefore, the ultimate purpose of our work is to analyze results of using intelligent applications in teaching a foreign language, which is not their core subject, to students of technical specialties. Our objectives are to carry out an educational experiment, comparing and contrasting the data of the control and experimental groups of students, and to receive student feedback with regard to using intelligent applications as part of the teaching and learning process.

2. Literature review

The most known international MOOC platforms are Coursera with 24 million users and more than 2000 courses at the end of 2017, and edX with 14 million users and more than 1800 courses. Both platforms offer language courses. Leading universities of Russia, namely, Moscow State University, Moscow Institute of Physics and Technology, Higher School of Economics, Moscow Engineering Physics Institute, National Research Technological University MISIS, Saint Petersburg State University, Peter the Great Saint Petersburg Polytechnic University, National Research

University of Information Technologies, Mechanics and Optics, Urals Federal University made their online courses available on these platforms. On completing a course, students took exams and received certificates issued by the universities. However, both platforms suspended the content from Russian universities following the international sanctions. Now the courses developed by Russian universities can be accessed through such educational platforms as Open Education, My Education (online.edu.ru) we study Emdesell, GetCourse, Justclick, Innovationbro, Memberlux, Zenclass, and others. Language courses are also on offer (in particular, English and Chinese, the most common business languages currently).

Using digital technologies in education is a new rapidly developing trend (Murzo, Chuvileva, 2021; Plario; Luchshie obrazovatelnye..., 2022). And one of the challenges teachers face today is contributing to its growth and sharing responsibility for all the aspects of intelligent information processing that should be taken into account while developing or upgrading learning courses in their field of study.

The list of web services frequently used both by secondary and higher education institutions includes the following: Cisco Webex, a multi-platform online service that allows students, faculty and staff to meet via conferencing and screen sharing, Google Classroom, a web service developed by Google for schools that aims to make it easier to develop, share and grade assignments in a paperless way, Google Forms, an online tool that allows you to create forms for collecting data, online testing, and voting, LearningApps, a free service to support teaching or self-study by offering interactive modules, Kahoot, a service that facilitates developing online quizzes, tests and surveys, Quizlet, a free online service that allows the user to design and work with flashcards and learning games of various types and in various areas (languages, culture, maths, geography, etc.), Popplet, a service for creating mental maps.

The institutions that choose to introduce digital learning often face the dilemma of whether to develop their own e-learning environment or use one of the existing digital platforms, either free or paid. The second option makes it possible to start the teaching and learning process sooner and with lower costs.

Tomsk Polytechnic University chose to develop its own system. The first in Russia adaptive learning system for teaching mathematics based on Plario platform was designed by researchers from Tomsk State University in cooperation with IT company ENBISYS (Plario). The scientists from this university together with researchers of Bryullov Consulting also developed Aktru, a unique digital platform with elements of AI, aimed at organization of teaching process for both contact and distance learning formats.mEdCrunch University education center at National Research Technological University MISIS also announced the launch of a platform for student knowledge assessment. The platform, as its developers believe, will enhance the learning by regularly informing students of their achievements and mistakes. Saint-Petersburg Mining University created new lines of research for its Educational Research Centre for Digital Technologies; within this project, Schneider Electric Company created a number of clusters based on Aveva software platform.

Digital learning management systems. The purpose of digital Learning Management Systems (LMS) is to create a unified database of e-courses and materials within an e-learning environment. They allow for both course and learner management. Learning with an LMS is equally successful in remote and contact formats, which actually means the possibility of blended learning. A distinction is made between cloud-based and server-based LMSs. The former are more often used in corporate education (iSpring online, TeachBase, Loop), while the server-based ones are employed in universities and learning centres, also for foreign language teaching. Another important consideration than the learning options offered by these applications is their cost. Among the most popular ones there are some that are free of charge; the best rated of the latter are such platforms as Moodle, Ilias, and Edmodo (The best educational platforms).

Mobile devices have become common, and their impact on practically all sides of human life is now unprecedented and manifold. Mobile technology provides the learners with more opportunities to access various internal digital services of higher education institutions at any time convenient for them (Mehdipour, Zerehkafi, 2013; Skornyakova et al., 2022). LMSs running on iOS and Android operating systems have certain advantages in this regard.

AI applications. Development of simple purpose-specific algorithms meant for effectively solving simple problems, combined with methodology from the field of AI, can be instrumental in optimizing the teaching and learning process (Lisovets, 2013; Rodionov, Tamp, 2022).

AI algorithms do not (and are not supposed to) replace the teacher, but they can take on most of the teaching routine this giving the teacher more time for professional development.

Today it is not enough for a platform to be just a repository of texts, videos, tests and communication tools. Personalized learning is based on intellectual processing of data from every learner (Boyko et al., 2022; Hinojo-Lucena et al., 2019; Watts, 2018). Big Data algorithms make it possible to create a learner profile so that the application used in the learning process provides the learner with information tailored to his or her specific needs and requirements (Cope, Kalantzis, 2016). This is of great importance not only with respect to testing, but also throughout the process of learning, so that the user is provided with optimised information and data. M. Pikhart from the University of Hradec Kralove (Czech Republic) in (Pikhart, 2020) cites the results of testing 10 mobile applications running on Android and iOS platforms that were designed for foreign language learning. The results show that in most of them, AI is not used to its full potential; only two of the applications in question comprised AI algorithms in speech recognition options.

There is also a known off-the-shelf solution, which is DialogFlow based on Google's cloud solutions, designed to make chatbots (Schipachev i dr., 2021). The platform offers a friendly interface, and many of the processes are performed automatically with a reasonably good quality. In addition, its free-of-charge version is often sufficient to create and test a virtual assistant. In other cases a paid service should be chosen, with the bot that not only gives information on the subject but also "hears" the learner as a teacher would. All in all, the use of intelligent applications in higher education institutions requires substantial investment on the part of the institutions themselves, as well as individuals and businesses.

3. Materials and methods

Development of AI algorithms. The strategy for introducing AI in higher education institutions, as in any other organisations, is a five-stage process of solving ordered and systematised tasks by successive teams (see Figure1) (Rodionov, Tamp, 2022). According to a number of researchers (Healey, 2020; Watts, 2018; Hinojo-Lisena et al., 2019; Gid po iskusstvennomu..., 2022), the use of AI can prove effective in more than ten areas pertaining to education. However, it should be remembered that the task of developing and structuring AI algorithms is elaborate and time-consuming. It requires a large number of databases, each provided by qualified experts, with the data sometimes turning out to be insufficient or incorrect. Every component must go through a rigorous check, and dedicated programs may be necessary to spot any possible errors. For example, for the technical staff of Tomsk State University it took 7 years to develop the content for its own e-learning platform website. The advantage is that the platform meets all the specific needs of the university and comprises a full range of effective components for organising the teaching and learning process.

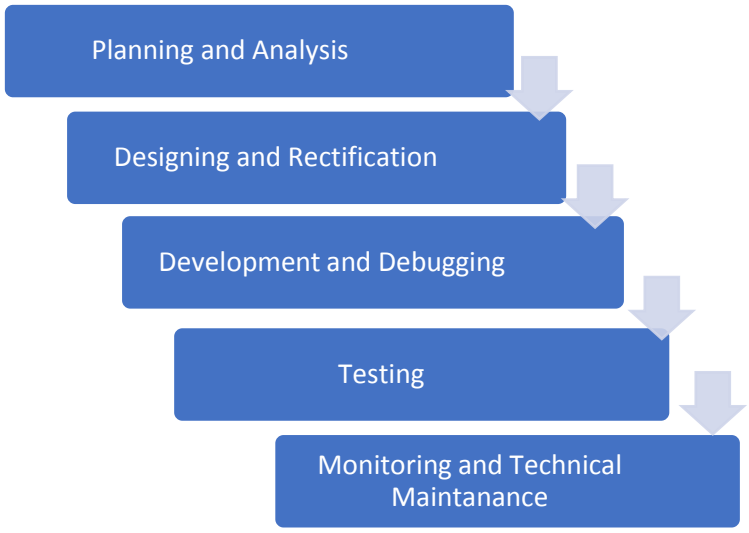

Fig. 1. Outline of an overall strategy for introducing AI in higher education (Rodionov, Tamp, 2022)

Difficulties in introducing AI technology may affect the following areas (AI in Education Market, 2018; Artificial intelligence in education).

In order to implement an intellectual and adaptive process, a computer-based language learning support system needs a specific architecture that comprises three essential closely interlinked components:

- A model of the knowledge area that contains information about a foreign language or certain aspects of the language targeted by the tasks (e.g. a comprehensive model of English verb tense system), an extensive set of exercises covering all the specifics for all levels of difficulty, combined with feedback, support comments and teaching guides underpinned by an empirically tested difficulty model comprising the relevant grammatical concepts.

- An assessment model that continuously monitors the progress of every individual learner in every activity, identifies errors and their types, and keeps the record of the learning time, number of attempts, use of feedback, methodological support, prompts and teaching aids.

- A model of a learner that retrieves and updates the data on their progress in the knowledge area as they study the subject.

Such factors as enhanced capability of digital resources, exponential increase in AI technology use, using virtual reality, and integration of digital learning environment into teaching and learning process underpinned by broadband Internet access and big data processing technologies allow for personalising the process of learning and for in-depth analysis of the individual characteristics of the learner (Artificial intelligence in education; Goddard, 2020). With all the results already achieved, AI is still at an early stage of development. The pandemic and the resulting need for distance learning have only accelerated the process of integrating AI technology into the education sector. By esteem of experts from the eLearning Industry platform, over 47 % of learning management tools will be complete with AI in the next couple of years (AI in Educational market, 2018).

In St. Petersburg Mining University, the electronic information and education environment includes personal accounts for teachers and students, corporate email system, and access to electronic libraries. LMS Moodle is also installed on the university website and so can be accessed by teachers. The system facilitates remote communication of the participants to the teaching and learning process through access to learning materials, file sharing and both synchronous and asynchronous communication (Makhovikov, 2021).

The following summary table gives examples of use of different elements of intelligent digital education platforms and systems in universities for instructional purposes, including teaching a foreign (English) language.

Table 1. Classification review of components present in electronic information and education environment of higher education institutions (compiled by the authors)

Type	Functions in the teaching and learning process	Examples
Massive online education courses	Improving skills and knowledge and developing competences in a specific field; preparing for study abroad; enhancing employment prospects	Coursera, edX, My Education FP
Internet servicesandportals	Administering learning assignments, video lectures (streamed or recorded); administering tests and quizzes, including online testing; online voting; progress assessment and analysis; sharing materials between students and teachers/ lecturers; data retrieval	Cisco Webex, Google Classroom, Google Forms, LearningApps
Digital learning management platforms	Distance learning and direct classroom instruction; testing; listening; monitoring of attendance and progress; feedback and sharing experience	Moodle, Ilias, Edmodo
Intelligent applications using AI algorithms.	Personalisation of the learning process; developing learner-oriented strategies;	University-developed adaptive learning

	creating learner profiles; optimisation of teaching and learning process; decreasing the share of repetitive/ routine teaching workload; using tools for visualising vocabulary; developing virtual tutoring services; provisions for teacher-learner communication and feedback	systems; chatbots: Virtual Talk App, Mondly, Memrise, Duolingo

In the spring of 2022, a group of teachers from Saint Petersburg Mining University took a training course at Innopolis University as part of a professional development programme intended for teachers of higher, secondary vocational, and additional vocational education within the framework of the federal project "Personnel for Digital Economy". The course was delivered via the educational platform of Innopolis University. After that, a number of the university study course programmes for different subjects were updated with the view to introducing digital technologies into the teaching and learning process in order to meet the growing requirements to university graduate preparation standards.

At the beginning of 2021, the survey was carried out among the students and teachers of Mining University (Kremcheeva i dr., 2021); it aimed at getting an insight into their attitude to the use of online technologies and covered all subject areas in general, not just the Foreign language. The results showed that most of the students were prepared and eager to try the new forms of learning. The majority of the teachers, on the contrary, regarded the use of digital methods as a threat to the quality of learning and student knowledge.

In order to estimate the motivation to use digital technologies and the prospects for further implementation of digital learning for the subject of foreign language in Saint Petersburg Mining University, in the autumn of 2022 a survey was conducted among students of the university specialty 21.05.06 "Oil and gas engineering and technology".

For statistical data processing, SPSS 17.0 software (IBM) was used. The attribute values are represented as observed frequencies (absolute numbers) and percentages. To compare the attributes, Pearson's chi-squared test was applied to confusion matrices. In the case of small frequencies (5 to 10), Yates' continuity correction was used. The differences were assumed as statistically significant at $p < 0,05$, where p is type I error probability in testing the null hypothesis.

The surveying showed that:

1. For students, the motivation to learn a foreign language is related to the specifics of their future professional activity (62 %), the possibility of doing research work (33 %) and self-development that includes enhancing their personal qualities, intellect, imagination, and creative thinking (5 %).

2. In preparation for classes and of home assignments, the majority of students (88 %) rely on digital technologies in as many as 60-70 % of cases.

3. Students turn to digital technologies for the performance of everyday tasks (study or work) almost as much as for leisure activities. The instruments most frequently used in preparation for classes are as follows: Coursera (25 %), Cisco Webex (20 %), Google Classroom and LearningApp cloud services (21 %), Moodle (17 %), open access e-learning materials (17 %).

4. The vast majority of respondents find it easy to find information on the Internet (98 %); however, only 53 % of the students select and evaluate the information they have found with regard to its accuracy, quality, reliability, and relevance, which indicates the need for awareness-raising classroom activities on the part of the teachers.

5. The vast majority of the students surveyed regard the rules and norms of behaviour during communication in digital environments as a necessity (90 %), with the remaining 10 % associating such rules and norms with restrictions to free speech, and 4 % of them stated the need to review the conventional rules of communication adapting them to the specifics of digital environment.

6. The majority of students (86 %) view electronic gadgets and the related technologies as in integral part of life and are aware of the need to protect the devices and personal data (92 %) while using them.

7. Another important criterion to explore in our study was to specify the students' own awareness of their professional learning needs and so their ability to choose the right digital tools while performing the training assignments. 95 % respondents acknowledged that they did not need any additional guidance, while 5 % would choose to ask the teacher for help.

The next stage was a pedagogical experiment aimed at testing the effectiveness of integrating digital technologies into the teaching and learning process, conducted at Saint Petersburg Mining University. Two groups of first-year students from Faculty of Oil and Gas Engineering took part in the experiment. Teaching of the experimental group (17 students) involved the use of digital technologies, while the control group (14 students) was taught in the traditional way.

The baseline level of parametres and factors to be monitored in the experiment was determined by an entry test taken by all the students. It was based on the material covered by the students before the start of the experiment and included four tasks. The test consisted of 30 questions with one point given for every correct answer, so the maximum number of points was the same as the number of test questions. The test was conducted in accordance with the traditional teaching model, in written form in a classroom; the students were given 30 minutes to complete it.

The testing results are presented in Table 2.

Table 2. Entrance test results (control group and experimental groups)

Mark	Points	Control group n = 14		Experimental group n = 17		Chi-square criterion	Statistical significance of differences, P
		Absolute number of students	Percentage of students	Absolute number of students	Percentage of students		
5 (excellent)	27-30	1	7	2	12	0.188	0.859
4 (good)	22-26	6	43	7	41	0.009	0.786
3 (satisfactory)	16-21	6	33	6	35	0.185	0.952
2 (fail)	≤15	1	7	2	12	0.188	0.859

Two groups of first-year students from Faculty of Oil and Gas Engineering took part in the experiment. Teaching of the experimental group (17 students) involved the use of digital technologies, while the control group (14 students) was taught in the traditional way.

Upon analyzing the outcomes of the survey and the entry test we proceeded to the next stage of the pedagogical experiment. This involved planning and designing tasks and activities for two different short sample courses for the two groups. The contact sample course was intended for the control group, while the distance learning sample course was designed for the experimental group.

Accordingly, the contact sample course included the following components: introducing new material to students with explanation on the part of the teacher; doing speech exercises and practicing a variety of speech activities in small groups; preparing and delivering presentations; entrance and final tests. The distance learning sample course included the following components: independent online search and research; working with information resources and learning materials (glossary, links to topic-related resources, etc.); doing a variety of practice tasks, including pre-communication activities; entrance and final questionnaires.

The last stage of the experiment included efficiency estimation of the foreign language teaching and learning model that was developed and tested. The effectiveness of teaching relying on digital learning was evaluated through a final questionnaire and a final test.

The final questionnaire offered to the experimental group was instrumental in taking the students' opinion on digital learning technologies. Over 85 % respondents said the course involving digital technologies was interesting to work with. More than 90 % of them found it practical to use digital technology to support the learning process. 83 % of the students found it easy to work with digital technology. Among the advantages of the updated study programme, students indicated the possibility to work in the learning environment at a convenient time and pace; the convenience of working in the learning environment, as all the necessary information and training materials were grouped together, easy to use and well structured; the opportunity to better prepare for the contact

class by studying in advance the material available in the e-learning environment. Among the disadvantages the students mentioned some technical problems, such as the impossibility to access the website because it was overloaded, problems with the Internet connection, etc.

Both the control and experimental group were given a common final test; the results were compared. The test was administered in written form in the classroom and included nine questions. The time given was 1 hour and 10 minutes, the total number of questions was 68, with students receiving one point for each correct answer. So the maximum number of points that students could score was the same as the number of questions in the test. The results of the final test are presented in Table 3.

Table 3. Final test results (control group and experimental groups)

Mark	Points	Control group n = 14		Experimental group n = 17		Chi-square criterion	Statistical significance of differences, P
		Absolute number of students	Percentage of students	Absolute number of students	Percentage of students		
5 (excellent)	60-68	2	14	2	12	0.043	0.741
4 (good)	47-59	4	29	8	47	1.106	0.496
3 (satisfactory)	35-46	6	43	5	29	0.606	0.688
2 (fail)	≤34	2	14	2	12	0.043	0.741

Over 50 % of students in the control group got satisfactory or lower marks in the final test, which shows insufficient acquisition of the course material. In the experimental group, the results were much better: only 29 % of the students got satisfactory marks, with over 50 % scoring “good” or “excellent”.

It is also of importance that the tasks which presented a problem for the students during the entrance test were completed with much better results in the final test. The average score for Task 2 (matching the words to make collocations) in the experimental group was 7.5 out of 8; and for Tasks 5 and 6 the average scores were 6 out of 8 and 4 out of 5 respectively.

Therefore, there are no great statistically significant differences between the control and experimental groups ($P > 0.05$) both for entrance test and for final test results. However, with all the significance of statistical data in evaluating experimental results, consideration should also be given to such important factors as keeping the students motivated by maintaining their interest in the subject, and developing their research and self-study skills.

The analysis of the final questionnaire and test outcomes together with overall analysis of the students’ performance in the experiment showed that studying the sample short course that involved digital technology enhanced the learning activity and motivation of the students. In particular, their class participation increased, and they regularly did the pre-communication activities and other training tasks.

Thus, all that was said above confirms the assumption that the use of digital learning enhances the quality and effectiveness of learning. Moreover, we can say that the digital learning sample course had a favourable impact on the lexical skills development and overall performance of the students, and consequently, facilitated the achievement of the ultimate goal, which is communicative competence.

Upon completing the sample course developed as part of the updated study course programme the students acquired new knowledge in the field of information and communication technologies, namely of the principles of searching for accurate and reliable information in the Internet and about contemporary digital tools for information collection and processing, and developed their skills of preparing presentations and/or other audiovisual content with Canva and Visme, searching for the relevant learning and profession-related content using the databases

of information and professional resources, including eLIBRARY.RU. They also mastered the foundations of infographics using Piktochart and Infogram and developed groupwork skills for digital environment by working with Padlet and Jumboard, and gained the experience of communication in the virtual environment through teleconferencing service, including Yandex Teleconference.

4. Conclusion

The impact of new digital technologies on education system goes further than didactics. Their use blurs the boundaries between formally organised learning environment of the classroom and the opportunities of learning at the convenient time and location outside the classroom.

Digital learning platforms are commonly used for running online courses, administering tests, tracking learners' progress and generating reports for teachers, sharing audio, video, text and graphic content, managing and monitoring students' independent study. The use of mobile applications in foreign language teaching is developing rapidly, and they prove effective even without the use of AI algorithms.

The opportunities offered by AI increase dramatically the effectiveness of digital educational platforms. This breaks a new ground for major innovations and development of new knowledge and practices. By 2023, more than 40 % of global education capital is projected to be spent on AI in education.

AI algorithms would be practical to use not just for teaching individual subjects but in information and education systems of higher education institutions as a whole. There are prospects of employing AI algorithms for admission and enrolment of students, improving accessibility for learners with disabilities, organising lifelong learning, and developing dedicated programmes adapted to the needs of different learners, thus allowing them to study without comparing their results and achievements with those of others, and so relieving social and academic pressures. However, due to the complexity of such systems, the development of AI-based learning environment that is adapted to different types of learners, at the same time ensuring high standards of both knowledge and practice, is still in its initial stage.

The authors hope for strengthened interdisciplinary cooperation of experts in foreign language teaching, computer linguistics, psychology of learning, computer-aided learning and Big Data, as well as multimedia designers in developing advanced language learning systems.

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