International Journal of Innovative Research and Scientific Studies, 8(3) 2025, pages: 1811-1823

IJIRSS
International Journal of Innovative Research & Scientific Studies

ISSN: 2617-6548

URL: www.ijirss.com

AI-driven digital facilitator for personalized post-course support of educators

Zhanat Nurbekova[1], Talgat Sembayev[2*], Meiramgul Zhetpisbayeva[3], Kanagat Baigusheva[4]

[1]*Abai Kazakh National Pedagogical University, Almaty, Kazakhstan.*
[2]*Astana IT University, Astana, Kazakhstan.*
[3]*Branch of the JSC, National Center for Advanced Training, Orleu, of Karaganda region, Karaganda, Kazakhstan.*
[4]*LLP "Digital Experts Group", Astana, Kazakhstan.*

Corresponding author: Talgat Sembayev (*Email: talgat.sembayev@astanait.edu.kz*)

Abstract

The current article aims to study the approaches and technologies for post-course support of teachers in the context of a new paradigm of continuous professional development. In a dynamically changing world, post-course support plays a significant role in ensuring sustainable professional development. This article proposes an innovative solution a digital personalized facilitator support for the post-course professional development period of teachers. The study employed a quantitative method with a sample size of 21,681 teachers to determine their educational needs, the use of AI, and the conditions for effective post-course support. About half of the respondents (40%) highlighted the importance of post-course support from coaches, colleagues, and administration, while more participants (75%) identified the need for AI tools for personalized professional development. The significance of the results is associated with the justification of an innovative solution to the problems of post-course support for teachers in the form of a patentable utility model of a digital facilitator. Its applicability as a facilitator in group sessions that monitor participants' actions shows the prospects for its implementation in other areas of the teacher's activity.

Keywords: Artificial intelligence, digital facilitator, educational technologies, post-course support, professional development of teachers, teacher qualification advancement.

DOI: 10.53894/ijirss.v8i3.6888
Funding: This research has been funded by the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant Number: BR21882260).
History: Received: 19 March 2025 / **Revised:** 23 April 2025 / **Accepted:** 28 April 2025 / **Published:** 9 May 2025

Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Institutional Review Board Statement: The Ethical Committee of the JSC «National Center for Advanced Training «Orleu», Republic of Kazakhstan has granted approval for this study.
Publisher: Innovative Research Publishing

1. Introduction

Conducting trainings, workshops and seminars has been significant along with the modernization of educational processes. The need for required skills and competencies from a certain specialist increases rapidly, requiring advanced training courses to be more effective and demonstrate sustainable results. In this regard, the concept of post-course support for teachers is being largely transformed into continuous professional development of teachers, leading to an unexplored research niche.

Professional development of teachers is one of the main issues on the current agenda of reforming and improving the quality of education [1]. Studies confirm that professional development of teachers is the key to solving contemporary educational issues, indicating its connection with improving the quality of education and improving the academic abilities of students [2-4].

Today, professional development of teachers in Kazakhstan is contextualized with professional development trainings and post-course support activities (here in after - PCS) [5]. PCS is recognized as an important aspect of continuous professional development that provides informational, tutoring, and methodological support, which facilitates the integration of up-to-date educational approaches and methods into teaching practice [6].

Results of longitudinal studies have shown that teacher learning continues further after particular training and becomes more embedded in the following three or four years of teaching practice. Therefore, considering that formal learning is one of the stimuli for changing a teacher's existing practice, it should be systematically supported until it becomes part of everyday practice [7-9].

Ventista and Brown's [8] systematic review of 125 articles on teacher professional development concludes that in a world where teachers are expected to become "high-level knowledge workers," schools must become learning organizations [8].

Therefore, when professional development is highly supported by institutions, teachers can collaborate and share ideas with colleagues, conduct joint lessons, and draw conclusions from their experiences. Collaboration can include feedback from colleagues or administrators, which helps teachers to adapt quickly and improve their work. The TALIS results (2018) show how providing opportunities for continuous professional development assesses the ways that teachers in different countries take to develop themselves. For example, in Singapore, 48% of teachers report participating in collaborative professional learning at least once a month (OECD average: 21%), while 39% participate in team learning with the same frequency (OECD average: 28%). Only a small percentage of teachers report that they have never received feedback in their schools (OECD average: 10%) [9].

Conducting research on the content, forms and conditions of the implementation of the PCS allows confirming that:

- Cooperation and support are key conditions for the effectiveness of the PCS [7].
- The system of continuous professional development requires not only participation in training or seminars but also conducting intensive PCS as well [8].
- Student involvement in learning is best ensured when teachers plan and implement new approaches with the support and feedback of experts and regular PCS group discussions [10].
- PCS as a system of methodological activities carried out by professional development organizations, is replaced by a process of continuous learning in cooperation with colleagues in their organization or in an online community and receiving formative feedback [11].
- The dynamic development of a group of teachers in a separate organization or online community becomes the subject of the PCS [8].
- PCS is adaptive in nature and is developed taking into account the needs of specific users or types of users [12].

In the context of the new artificial intelligence (AI)-based education ecosystem, educators will both inevitably experience innovations and encounter challenges. The main ones are the increasing demands on teachers' ability to use educational technologies, including those based on AI, and new challenges to teachers' professional competencies in line with transformations in educational resources and teaching models. The combination of virtual and real educational environments allows for diversification of learning formats and adaptation of educational content to meet the unique needs of each student [13-20]. The gradual diversification of the teacher's role can lead to a self-identification crisis and increased isolation of the teacher's work in the event that he or she does not adapt to the new educational landscape [21].

The existing studies show that the main AI technologies in education include Intelligent Learning Management Systems, Intelligent Agents, Educational Robotics, Virtual Simulation Teaching Platforms/Labs, Intelligent Evaluation, various content generation, etc.

The conclusions regarding the PCS's content, forms and implementation conditions emphasize that the PCS should be adaptable and is designed with consideration for the needs of specific users or types of users.

The study of teachers' perceptions of what they learned at the stage of knowledge and skills implementation acquired in the course or seminar and the fact that they learned and continue to use, also confirms the importance of support and feedback as key conditions in professional development [7]. The rapid development of educational resources, changing learning approaches, and the introduction of AI into the educational process may outpace their integration into professional teacher training programs. In this sense, short-term training may be insufficient to fully assimilate new knowledge, technologies, or methods, which impedes their effective implementation in real educational settings. Without practical experience and feedback, it may be difficult for a teacher to understand how effectively he or she is using new knowledge. Such a gap between theoretical understanding and practical application may indicate the need for more targeted professional development and PCS. Studies showed that there is a need for personalized post-course support that takes into account the specific difficulties of teachers, the characteristics of an authentic classroom, and real educational conditions. Therefore,

timely feedback helps to develop teachers' research skills in the process of solving specific and practical problems in the classroom and to improve the student's academic success [22]. At the same time, years of observing teachers' post-course activities also allow us to conclude that it is difficult for teachers to improve their teaching and learning practices without constructive feedback on how effectively they apply new knowledge gained in the course/seminar in the classroom. Traditional forms of PCS cannot ensure the efficiency and mobility of feedback and help teachers overcome existing isolation.

In addition, when choosing the forms and content of PCS, it is necessary to consider the different levels of professional knowledge and skills of teachers. Most of the time, PCS is implemented at the teacher's workplace, and often the course/seminar trainer cannot be present, which complicates the implementation of PCS in the traditional form, and in some cases makes it even ineffective due to the lack of data on the use of the knowledge acquired during professional training by the teacher in his or her practice. Therefore, the problems of low interactivity and weak communication of traditional PCS forms require innovative solutions. Providing the necessary data and enhancing the interactivity of PCS are possible through the development of innovative solutions using AI. This would strengthen participants' interaction in the educational process and improve the practical application of the knowledge gained during PCS based on data on teachers' classroom activities.

Research problem: Insufficiency of innovative AI-based solutions for effective post-course support of teachers.

Research objective: To develop an evidence-based innovative solution to the problems of post-course support of teachers in the form of a patentable, useful model of a digital facilitator.

1.1. Research Questions

1. Identifying teachers' needs while using artificial intelligence (AI) for professional development in the post-course period.
2. Developing a useful model of a digital facilitator for optimizing PCS.

A systematic literature review on AI-based education tools has shown that several issues need to be addressed for AI-based PCS.

To intensify the PCS, data on the teacher's use of what was learned in the course or seminar in his/her teaching practice is necessary. An example of data collection is the electronic portfolio of the YachaY project [23]. Particularly, both online and with the help of portable devices, the YachaY collects various evidence, including academic qualifications, research publications, conference participation, informal learning outcomes, etc. Based on the information stored in the electronic portfolio and through formulating questions, the YachaY system analyzes all the data and offers one or more routes for professional development. YachaY takes into account the possibility of adapting the training program to the teacher's experience and professional aspirations, but is not aimed at solving current problems that arise in the teacher's work or receiving relevant feedback.

Education research has shown that positive social interactions between students and instructors improve learning outcomes. In the context of low ratios of course trainers to trainees, it is difficult for teachers to receive sufficient and personalized support. A study by Bii et al. found that the interactive nature of chatbots provides opportunities for social interaction and facilitates the learning process.

The development of AI and conversational agents such as chatbots provides an opportunity for PCS to meet the needs of different teacher categories (based on qualifications, experience, age, psycho-emotional characteristics, place of residence, etc.). The study by Gupta and Chen aimed to explore the capabilities and requirements of a chatbot as an intelligent assistant to promote learning equity [24]. Conducting interviews using a chatbot was more likely to encourage participants to provide information in their everyday context than in an interview conducted by a person. Regarding the goal of our study, it is significant to consider other researchers' findings on creating an accessible, interactive, and confidential way to support a teacher's professional development. Therefore, it is important for us to solve the problem of creating a resource for obtaining up-to-date data on a teacher's activities in an authentic classroom. An interview after lessons may not always objectively reflect how effectively a teacher used the knowledge gained during a professional development program.

Differentiated support can be realized through educational platforms that combine human tutors and AI-based mathematical software Thomas et al. [25] or platforms with pedagogical agents Apoki et al. [26]. Kim et al. [27] argue that pedagogical agents can imitate the traits of an ideal human tutor, including professional, interpersonal communication and caring skills [27]. Such platforms are effective for building an individual development route for a teacher, but they do not solve the problem of reducing the isolation of a teacher's work and do not provide the opportunity to receive feedback during group work with colleagues.

Great potential for personalized, adaptive PCS lies in the intersection of computer science, artificial intelligence, cognitive psychology and educational technology. The integration of such systems supports both individual and collective learning. Therefore, group cognition using an intelligent tutoring system and performance prediction in a collective learning paradigm shows potential research implications for future studies [28].

Open domain digital resources can be customized based on the user's personal data and past behavioral records, and learn their preferences over time to provide suggestions and even predict needs [29]. Therefore, AI technologies are transforming education into a data-driven system [30].

Thus, the following characteristics are important for the creation of digital resources for teachers' PCS.

- Supporting teachers with different levels of professional training and psycho-emotional characteristics and abilities.
- Creating a safe space without judgment and evaluation.
- Receiving feedback and analyzing it.
- Making it possible to rely on the professional experience of colleagues for the purpose of jointly solving similar problems.

- Reducing the isolation of the teacher's work and accelerating the horizontal dissemination of knowledge.

The above-specified characteristics are inherent to our proposed device, the "Digital Facilitator."

A comparative analysis of existing solutions, such as online proctoring systems, U.S. Patent No. US11790798B2 [31] and intelligent digital assistants, China Patent No. CN110313153B [32] shows that none of these systems provides functionality equivalent to the proposed device. For example, proctoring systems are designed to monitor test takers in real time, but do not take into account the emotional and physiological parameters of participants. At the same time, intelligent assistants recognize speech and gestures, but are not adapted to analyze group dynamics and are not mobile. The digital teacher assistant system, information interaction method and information processing method, China Patent No. CN110148318B [33] includes subsystems of intelligent reading guidance, interactive questions and answers, state detection and a digital teacher assistant database, and belongs to the field of information interaction and information processing. Thus, it is suitable both for online education and regular offline classes. It should be noted that this system is not a portable Smart-device and does not include analysis of group work of the class and abstracted emotional state of the participant (analysis without reference to personal data of the participants of the PCS and without direct processing of facial images and saving of photo-images of faces) with recommendations.

AI tutors and other intelligent learning systems are aimed at transmitting information and personalizing the learning experience of teachers in a specific professional area. In contrast, the digital facilitator is focused on analyzing practical activities, such as supporting and optimizing group interaction between a teacher and students. It also promotes the professional development of a teacher by analyzing group interactions and making recommendations for improving the process.

The introduction of AI in education requires addressing many ethical and practical issues during its application. According to the UNESCO recommendations (Recommendation on the Ethics of Artificial Intelligence https://unesdoc.unesco.org/ark:/48223/pf0000380455), it is necessary to ensure confidentiality and data protection, compliance with ethical issues, and take into account the participants' readiness to implement AI tools. Following this, it should be noted that when using the digital facilitator, data personalization is excluded as well as the data is not stored while processing a video stream. To determine the readiness of teachers to implement AI tools, a mass survey of teachers was conducted, the results of which are presented below.

2. Methods and Materials

The study of the effectiveness of innovative post-course support for teachers is accompanied by the identification of initial needs and the proposal of new solutions.

To study employed a quantitative survey approach, which was conducted in May 2024. Particularly, the survey aimed to identify professional development interests and preferences of heads and teachers of secondary schools with the focus on post-course support. The survey also contained questions aimed at forming new proposals and solutions based on AI.

The total final sampling size was 21,681 teachers from all regions of Kazakhstan. The mass survey was organized by a consortium including the "Orleu" National Professional Development Agency of Teachers and four regional universities. The Agency has branches in all 20 regions of Kazakhstan and monitoring services, which allowed it to conduct a large-scale study covering teachers of various qualification categories. The consortium's research is funded by the state, as indicated in the "Acknowledgement" section.

The composition of teachers by work experience constituted the following proportion. Most teachers had more than 20 years of experience - 8,364 people, which is 38.6%. 5,924 people (27.3%) are teachers with work experience from 11 to 20 years, 3,999 people (18.4%) have experience of 5-10 years, and 3,394 people (15.7%) have less than 5 years of experience. If we look at the data by qualification category, the largest number of respondents are teachers with the qualification category of "teacher-moderator" (5,725 people, 26.4%), followed by teachers with the qualification category of "teacher-expert" (5,661 people, 26.1%), then teachers with the qualification category of "teacher-researcher" (4,534 people, 21%), and teachers without a category (4,775 people, 22%). The remaining number are teachers with the qualification category of "teacher-master" (210 people, 0.95%), the first category (285 people, 1.3%), the second category (206 people, 0.95%), and the highest category (285 people, 1.3%).

The composition of teachers by work experience constituted the following proportion (Table 1).

Table 1.
The proportion of teachers by work experience.

Work experience	More than 20 years	11-20 years	5-10 years	Less than 5 years
Share	38.6% (N=8,364)	27.3% (N=5,924)	18.4% (N=3,999)	15.7% (N=3,394)

As shown in Table 1, most teachers were highly experienced teachers with more than 20 years of experience, while teachers with 11-20 years of experience composed almost one-third. The proportion of novice teachers and those who had 5-10 years of work experience shared a similar proportion in the survey.

The composition of teachers by qualification category constituted the following proportion (Table 2).

Table 2.
The proportion of teachers by qualification category.

Qualification category	Teacher-moderator	Teacher-expert	Teacher-researcher	Without a category
Share	26.4% (N=5,725)	26.1% (N=5,661)	21% (N=4,534)	22% (N=4,775)

As shown in Table 2, teachers with the qualification categories of "teacher-moderator" and "teacher-expert" composed more than half of all respondents. The highest, "teacher-researcher" qualification holders composed similar share (21%) to those who had no qualification (22%). The remaining number were teachers with the qualification category of "teacher-master" (210 people 0.95%), the first (285 people 1.3%), the second (206 people 0.95%) and the highest (285 people 1.3%) category.

The questions of the survey can be divided into two main groups.

Group 1 – questions concerning continuous professional development which were about.

- Course formats (online/offline).
- Course topics that are of greatest interest and correspond to the current trends.
- Motivation for participation in continuous professional development programs.
- Factors that contribute to increasing the effectiveness of post-course support.

The respondents were offered conditions such as the presence of regulatory framework, support from the course/seminar trainer, the presence of a professional development goal, support from colleagues and administration, and the presence of a methodological that may influence post-course support.

The survey also touched upon personal factors, including the need to improve practice, methodological work within an educational institution, financial motivation, the presence of a special free day, the example and influence of colleagues that may potentially contribute to the professional development of a teacher in the post-course period.

In addition, the survey contained questions aimed at identifying factors that hinder professional development in the post-course period such as personal inactivity, disappointment due to previous failures, lack of support from colleagues and administration, lack of time, limited resources, lack of clarity about the goal of professional development, etc.

Group 2 – questions exploring teachers' awareness of artificial intelligence and its use in their professional activities. The questions helped to identify teachers' experience of using AI in their work and to determine potential areas for optimizing professional growth. The following options were proposed: development of individualized lesson plans, automation of assessment and feedback, interactive educational simulations, and analysis of learning process data to improve teaching methods. Along with the question specifying AI methods and technologies, it was possible to identify educational needs that affect effective post-course support. They included adaptive learning using machine learning, recommender systems, chatbots for support and consultation, and big data analysis.

This group was also asked clarifying questions about pedagogical strategies integrated with AI. Pedagogical strategies such as developing critical thinking and problem-solving, project-oriented learning, game-based learning, and creating collaborative projects were suggested as possible options.

The survey also considered questions on challenges and risks in integrating artificial intelligence with the process of continuous professional development of teachers, along with the ways to overcome them and solve them.

The reliability coefficient of the questionnaire was calculated using Cronbach's Alpha formula, which reflects overall and internal consistency of the questions. Due to the high response rate, a script was written in the Python programming language using the Numpy and Pandas libraries for processing large data (Figure 1). According to the formula, the variance of each question and the total scores were calculated. As a result of the calculations, the reliability coefficient was 0.82. This means that the questions correlate well with each other and the questionnaire has high reliability.

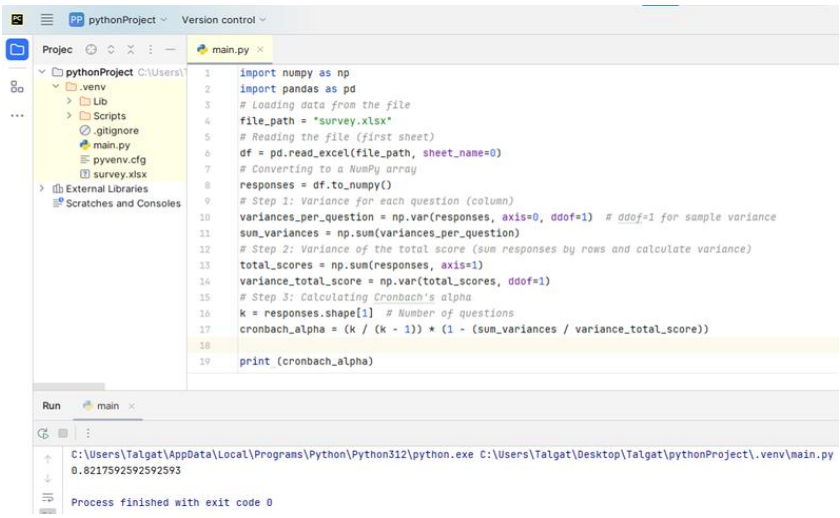

Figure 1.
Python script.

In addition to the survey data, the consortium also conducted in-depth interviews and focus groups with 50 school teachers from different regions, as well as expert interviews with 20 teachers of “Orleu” branches from 8 regions. One of the main findings of qualitative data showed the need to develop new organizational forms, resources, and mechanisms of planning and organizing effective, continuous professional development of teachers, including PCS. Also, forms, resources and mechanisms of professional development should correspond to the dynamic development of complex societal and educational challenges [34].

The next stage of the study was the development of a digital device model that helps to meet the needs of teachers at the post-course stage. The device plays the role of a digital assistant in conducting training sessions, trainings, group sessions in post-course support. This prompted us to call it a "Digital Facilitator."

The methodology for developing a digital facilitator for post-course support is based on interdisciplinary and R&D approaches that combine traditional pedagogy, psychology, AI technologies, radio electronics, and digital pedagogy.

The methodology includes the following stages: 1) collection and analysis of pedagogical needs, behavioral and emotional indicators of students, 2) design of the architecture of the module for recognizing emotional responses to the learning process, 3) 3D modeling, 3D printing, and design of electronics for a mobile device for collecting and interpreting feedback in the teaching process, 4) training a pre-trained model to recognize emotions, 5) creation of a prototype and final testing. The use of emotional artificial intelligence allows for recognizing and interpreting the emotional state, reactions, and activities of students during the classes, which provides the teacher with data for making valuable pedagogical decisions. At the same time, feedback, motivation level, and quality of communication of students during the learning process are also assessed. Pedagogical approaches, such as personalized learning, allow for adapting the content of support formats and tracking the teacher's progress in line with the level of achievements and competencies in the learning process. Ensuring compliance with the principles of digital didactics, such as the principle of interactivity and feedback, the principle of modularity, the principle of flexibility, and the principle of continuous learning, creates individual and flexible development trajectories for teachers. In the post-course period, through receiving recommendations and reminders from the digital facilitator about a specific point of growth or risk in the teaching process, the continuity of professional development is ensured for teachers. Compliance with the methodological principles of personalization, ethics, flexibility, and adaptability, in turn, ensures the protection of the personal data of teachers and students in accordance with accepted standards (for example, GDPR). For this, emotional AI is implemented through well-known algorithms for classifying and interpreting emotions, but instead of real pictures and videos, their numerical characteristics and anonymized data on the educational activities of subjects of the educational process in the form of a time series are processed.

The "Digital Facilitator" is a Smart device with a video camera that is used to conduct various classes or trainings. This device is an intelligent assistant that facilitates classes, courses and trainings for the professional continuous development of experts in various industries. Along with this, it can be used as an individual consultant for a wide range of tasks that require certain analysis.

The "Digital Facilitator" offers innovative solutions to improve interaction in groups, providing tools for analyzing the emotional and physiological state of participants, recommendations for optimizing group work. The device collects data using special signals, which allows for the formation of recommendations in real time aimed at improving the involvement and productivity of participants.

The model consists of three main parts: a basic stationary cylinder (1), a 360-degree rotating cylinder (2), and an upper part with a video camera (3) capable of rotating vertically by 180 degrees (Figure 2-3).

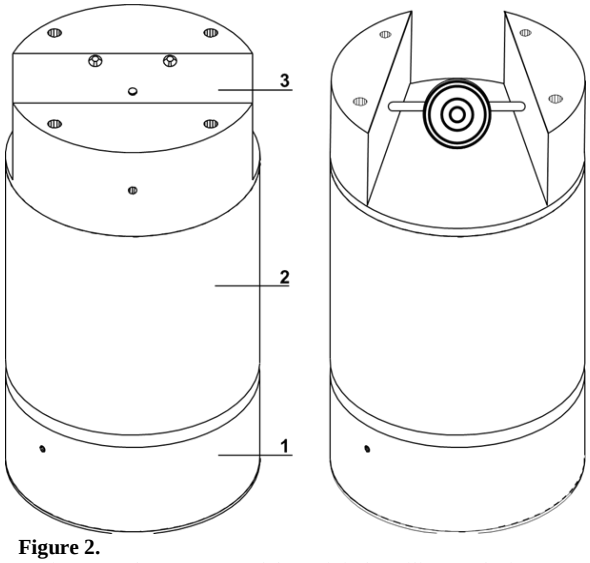

Figure 2.
Basic external appearance of the “Digital Facilitator” device.

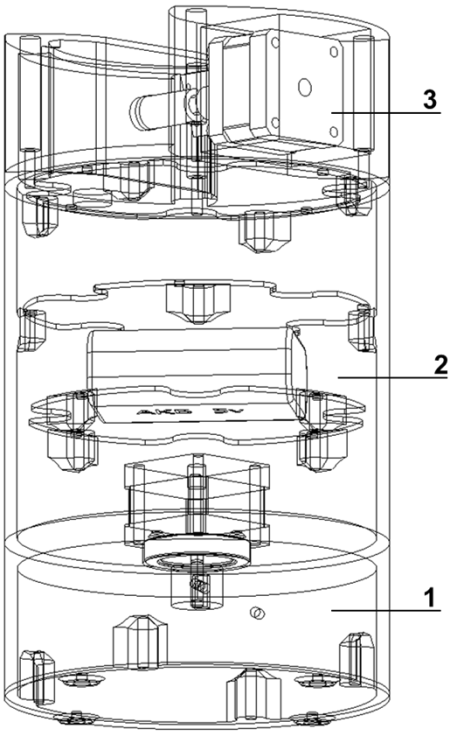

Figure 3.
Internal side view of the "Digital Facilitator" device.

Data transfer is carried out in the following way (Figure 4).

1. The camera collects depersonalized data of the participants of the educational event.
2. The single-board computer processes and transmits this data to the server via a secure communication channel.
3. The server processes this data using AI algorithms, which can abstractly analyze the emotions and behavior of the participants.
4. The processed data is stored in a secure database.
5. At the last stage, decisions are made for further use and recommendations.

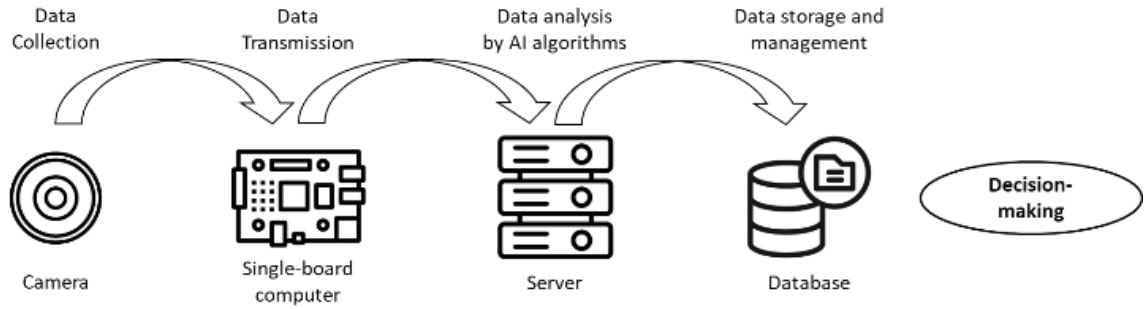

Figure 4.
Data transmission of Digital facilitator.

The key advantages of the proposed device are its autonomy, mobility and safety for personal use. The user can freely carry the device, which is convenient for individual and group work activities. In terms of its functions, the device surpasses existing analogues, such as intelligent stations, providing deeper analysis and recommendations in the process of group work. The "Digital Facilitator" device can help to improve the quality of training, achieve high results in meetings and training, and also allows for changing strategies for working with a group to achieve effective results.

3. Results and Discussion

The survey results of the first stage of the study showed that modern approaches to post-course support require innovative solutions for the continuous professional development of teachers.

Over the past year, 76.4% of teachers took part in continuous professional development programs, most of which were trained online, and 60.7% noted the need for additional training after the courses. Only 33.8% of teachers receive regular support after the courses.

The following conditions were highlighted for effective post-course support for professional development:

- Availability of regulatory framework – 33.7%.

- Support of the course/seminar trainer – 21.8%.
- Availability of a professional development goal – 19.2%.
- Support of colleagues, administration – 15.6%.
- Availability of a methodological topic – 9.6%.

Limited resources (80.9%), including time, methodological and informational, were the main factors hindering the professional development of a teacher in the post-course period.

The results of the survey for the first group showed that teachers are interested in professional development and associate it primarily with training in advanced training courses and additional training on a specific problem that may be related to the goal of professional development.

The results for the second group of questions, about teachers' awareness of artificial intelligence and its use in professional activities, showed that the majority of respondents (66.2%) had no experience working with AI.

While 75% of respondents considered AI as a useful tool for personalized learning and increasing adaptability, most teachers preferred areas such as the development of individualized lesson plans (35%), analysis of data on the learning process (22.1%), and automation of assessment and feedback (16.8%).

Regarding the methods and technologies that are most promising for supporting personalized learning, more than 50% of respondents focus on data analysis technologies and differentiation of educational material (Figure 5).

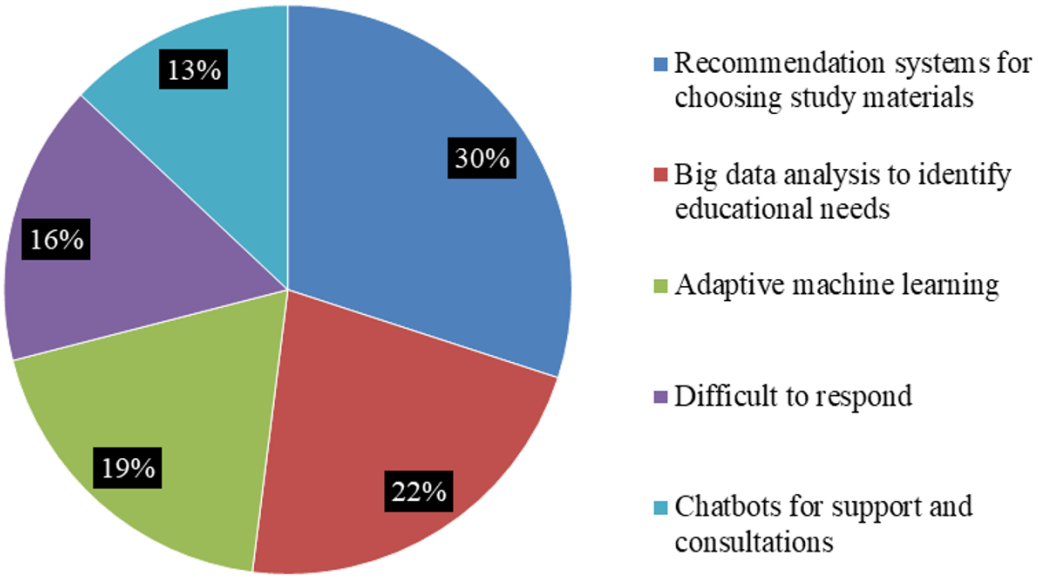

Figure 5.
Distribution of responses to the question "Which artificial intelligence methods and technologies do you consider the most promising for supporting personalized learning of teachers?".

Young teachers with less than 5 years of experience consider adaptive machine learning to be the most promising, which shows their interest in the use of AI and new technologies.

Teachers consider that integrated pedagogical strategies with AI are most effective when using AI for developing critical thinking and problem solving (36.2%), project-based learning using AI to implement real-world tasks (19.2), and game-based learning using artificial intelligence (17.9%). Thus, the integration of AI requires not only technological but also methodological training of teachers.

The widespread use of generative AI has a significant impact on the quality of education including the increase of education availability and flexibility (30%), improving the quality of teaching materials and methods (22%), and enriching the learning process through the inclusion of interactive and multimedia resources (22%). In general, improving the quality of teaching materials and methods using AI is noted by teachers with more than 20 years of experience.

Nevertheless, half of the respondents believe that the main challenge and risk in integrating AI into the process of continuous professional development of teachers is the lack of qualified resources for training teachers to work with AI (Figure 6). Particularly, for the response "Other", risks such as increased digital dependence, lack of "live" communication, fears that AI will replace teachers, and technical problems were noted.

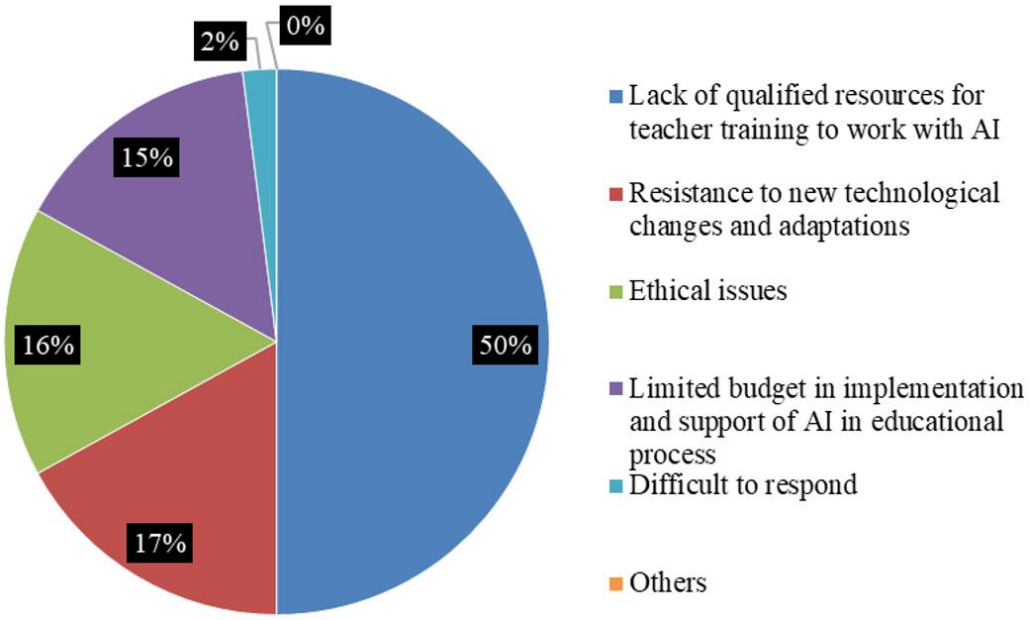

Figure 6.
Distribution of responses to the question "What challenges and risks do you see in integrating artificial intelligence into the process of continuous professional development of teachers?".

Accordingly, to overcome these risks and challenges, close to half of the respondents (40.6%) chose to design AI-specialized courses, while close to two-thirds (27.9%) showed that there is a need to organize master classes and seminars to demonstrate the advantages of AI.

The findings show that the potential of AI in education is high, but there are serious barriers, such as a shortage of personnel, resistance to change and limited budgets. Successful integration of AI into the educational process requires a comprehensive program that includes funding, training, ethical issues and various educational initiatives for teachers.

Based on the first stage of the survey study, the need for innovative solutions for post-course support for teachers was identified. Therefore, a model of the "Digital Facilitator" was developed as an AI-based operating device with its subsequent implementation. This was the second stage of the study.

At the implementation stage, the device was equipped with a modern single-board computer (for example, Orange Pi 5 Plus, Radxa Zero 3W) and an autonomous power source, which allows data collection, the performance of complex calculations and various operations (Figure 7-8).

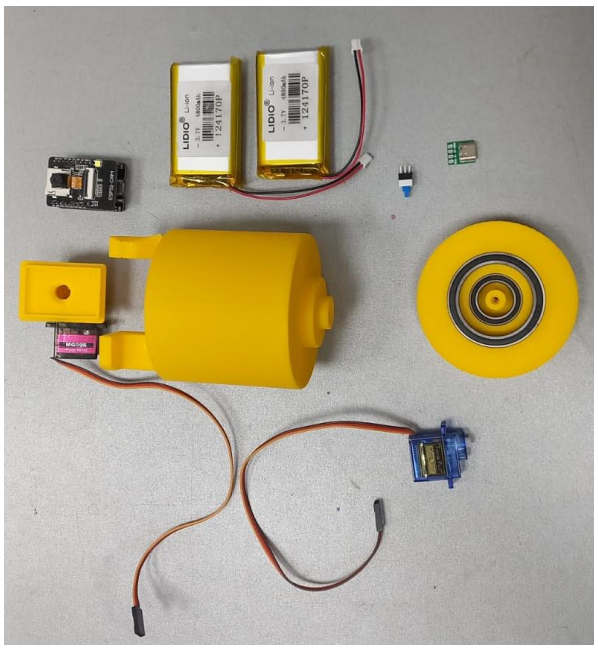

Figure 7.
Digital facilitator.

Figure 8.
Digital facilitator.

The "Digital Facilitator" consists of.

1. Stationary small cylinder - ABS (acrylonitrile butadiene styrene) / PLA (polylactide) plastic. The basic, motionless, stationary small cylinder, equipped with a stepper motor (e.g., NEMA17) and secured with a special inverted shaft;
2. Main rotating cylinder - ABS / PLA plastic. The main cylinder rotates horizontally by 360 degrees. The main body is divided into three sections: the lower section contains the electric motor, the middle section is designed for the battery (AKB), and the upper section contains a single-board computer.
3. Upper part - ABS / PLA plastic. The upper part of the device is equipped with a video camera, which can rotate vertically by 180 degrees using a stepper motor.

The technical advantages of the "Digital Facilitator" are achieved due to its autonomy, mobility and safety for personal use. Particularly, this is maintained by rechargeable batteries, a 360-degree rotating video camera and an integrated artificial intelligence system for anonymized analysis of the emotional and physiological state of participants, as well as a single-board computer with an open embedded software system for analyzing the emotional and physiological state of session participants, providing processing and generating recommendations for group work facilitation with the possibility of wireless remote control (such as Wi-Fi or Bluetooth). The functionality of the "Digital Facilitator" is available for updating and expanding its existing functions. With technological development, the proposed device can be improved through the use of components based on the latest achievements of science and technology, changing the size of the device and the openness of the software.

Altogether, based on the study results, the “Digital Facilitator” device was developed. Consequently, the National Institute of Intellectual Property issued a patent for a utility model for this device where the information about the patent can be accessed on the website of the state register of inventions and utility models of the Republic of Kazakhstan (Figure 9) [35].

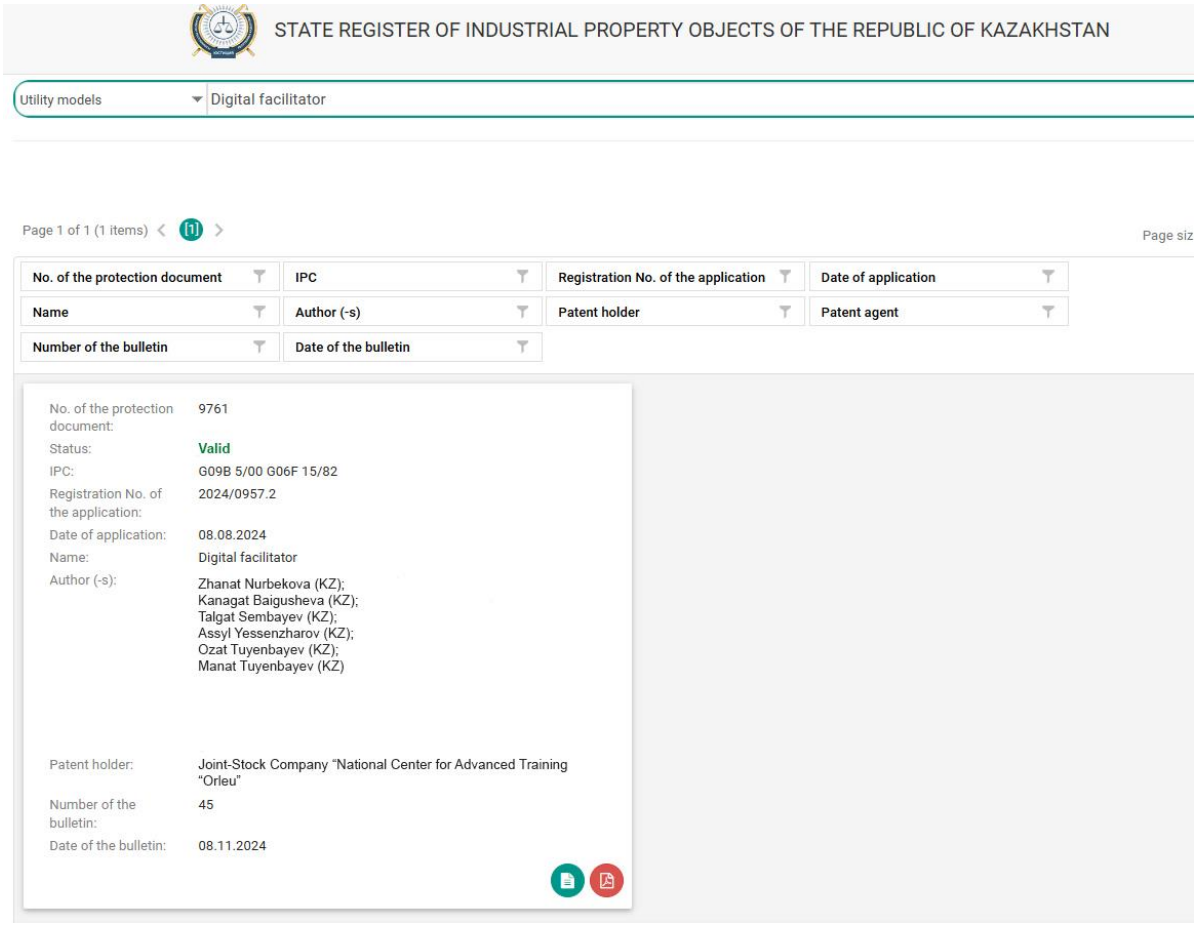

Figure 9.
Utility model.

The application of the "Digital Facilitator" can be expanded through integrated software. For example, it can be used as an individual consultant to organize and conduct fitness training or monitor the actions of specialists working in difficult and stressful conditions. The artificial intelligence-based system analyzes data from a video camera, actions and the psycho-emotional state of the user, and generates personal recommendations to optimize task performance. Promising areas of application of the developed "Digital Facilitator" model include education, corporate training, group behavior research, medical and psychological practice, work in complex production conditions, sports coaching, creativity, and art.

Thus, the "Digital Facilitator" model is an innovative solution aimed at improving the quality of group and individual work or training that allows users to effectively plan and analyze their activities based on the data received. Additionally, it also has great potential for expanding its application and functionality on a larger scale.

4. Conclusion

To conclude, the paradigm shift from advanced training to the concept of continuous professional development (CPD) requires new approaches and innovative solutions for organizing effective post-course support for teachers. The most important condition for increasing the effectiveness of CPD is overcoming key resource barriers such as time, methodological, and informational, which were noted by the majority (80.9%) of surveyed teachers.

The developed device "Digital Facilitator" can provide a significant advantage over traditional methods of post-course support. Due to its convenient, adaptive and accessible interface, it provides teachers with personalized recommendations based on abstracted data analysis, helping to plan effectively and analyze their professional activities.

Future research implications may include.

- Conducting additional tests of the “Digital Facilitator” in various pedagogical conditions to assess its effectiveness and adaptability.
- Improving functionality of the “Digital Facilitator” by adding feedback tools and personalized educational routes.

Thus, the proposed innovative AI-based solution contributes to the development of an effective ecosystem for continuous professional development of teachers, offering a scalable and practical tool for improving their professional competence.

References

[1] National project, "Quality education "educated nation," Ministry of Science and Education of the Republic of Kazakhstan. No. 726, 2021.

[2] M. Shin, L. M. Kreibich, and J. Tulivuori, *Teacher professional development case studies: K-12, TVET, and tertiary education*. Philippines: Asian Development Bank, Manila, 2021.

[3] L. Darling-Hammond, M. E. Hyler, and M. Gardner, "Effective teacher professional development," *Learning Policy Institute*, 2017.
[4] R. Sancar, D. Atal, and D. Deryakulu, "A new framework for teachers' professional development," *Teaching and teacher education*, vol. 101, p. 103305, 2021.
[5] Order of the Minister of Education and Science of the Republic of Kazakhstan dated, "On approval of the Rules for organizing and conducting advanced training courses for teachers, as well as post-course support for teacher activities," Retrieved: https://adilet.zan.kz/rus/docs/V1600013420, 2016.
[6] R. N. Safina, "Post-course support of teachers' professional development in the framework of professional development programs," vol. 3, p. 16, 2018.
[7] K. Koellner, N. Seago, A. Riske, N. Placa, and D. Carlson, "Teachers' perceptions and uptake of professional development overtime," *International Journal of Educational Research Open*, vol. 6, p. 100308, 2024. https://doi.org/10.1016/j.ijedro.2023.100308
[8] O. M. Ventista and C. Brown, "Teachers' professional learning and its impact on students' learning outcomes: Findings from a systematic review," *Social Sciences & Humanities Open*, vol. 8, no. 1, p. 100565, 2023. https://doi.org/10.1016/j.ssaho.2023.100565
[9] OECD, *TALIS 2018 results (Volume I): Teachers and school Leaders as lifelong learners, TALIS*. Paris: OECD Publishing, 2019.
[10] J. Neumayer DePiper, J. Louie, J. Nikula, P. Buffington, P. Tierney-Fife, and M. Driscoll, "Promoting teacher self-efficacy for supporting English learners in mathematics: Effects of the Visual Access to Mathematics professional development," *ZDM–Mathematics Education*, vol. 53, pp. 489-502, 2021. https://doi.org/10.1007/s11858-021-01227-4
[11] R. Coe, C. Rauch, S. Kime, and D. Singleton, "Great teaching toolkit: Evidence review," 2020.
[12] N. Kirsten, J. Lindvall, A. Ryve, and J.-E. Gustafsson, "How effective is the professional development in which teachers typically participate? Quasi-experimental analyses of effects on student achievement based on TIMSS 2003–2019," *Teaching and Teacher Education*, vol. 132, p. 104242, 2023. https://doi.org/10.1016/j.tate.2023.104242
[13] X. Chen, H. Xie, D. Zou, and G.-J. Hwang, "Application and theory gaps during the rise of artificial intelligence in education," *Computers and Education: Artificial Intelligence*, vol. 1, p. 100002, 2020. https://doi.org/10.1016/j.caeai.2020.100002
[14] J. Ge and J. C. Lai, "Artificial intelligence-based text generators in hepatology: ChatGPT is just the beginning," *Hepatology Communications*, vol. 7, no. 4, p. e0097, 2023. https://doi.org/10.1097/hc9.0000000000000097
[15] N. Rane, "Enhancing the quality of teaching and learning through ChatGPT and similar large language models: Challenges, future prospects, and ethical considerations in education," *Future Prospects, and Ethical Considerations in Education*, 2023.
[16] M. Mujiono, "Educational collaboration: Teachers and artificial intelligence," *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran*, vol. 9, no. 2, pp. 618-632, 2023. https://doi.org/10.33394/jk.v9i2.7801
[17] A. M. Al-Abdullatif, A. A. Al-Dokhny, and A. M. Drwish, "Implementing the Bashayer chatbot in Saudi higher education: Measuring the influence on students' motivation and learning strategies," *Frontiers in Psychology*, vol. 14, p. 1129070, 2023. https://doi.org/10.3389/fpsyg.2023.1129070
[18] J. M. Lodge, K. Thompson, and L. Corrin, "Mapping out a research agenda for generative artificial intelligence in tertiary education," *Australasian Journal of Educational Technology*, vol. 39, no. 1, pp. 1-8, 2023. https://doi.org/10.14742/ajet.8695
[19] M. A. S. Khasawneh, S. M. Ismail, and N. Hussen, "The blue sky of AI-assisted language assessment: Autonomy, academic buoyancy, psychological well-being, and academic success are involved," *Language Testing in Asia*, vol. 14, no. 1, p. 47, 2024. https://doi.org/10.1186/s40468-024-00318-9
[20] D. M. Heeg and L. Avraamidou, "The use of artificial intelligence in school science: A systematic literature review," *Educational Media International*, vol. 60, no. 2, pp. 125-150, 2023. https://doi.org/10.1080/09523987.2023.2264990
[21] W. Qingmin, L. Mingyong, X. Kaiyue, and Q. Xue, "Analysis and strategies of the professional development of information technology teachers under the vision of artificial intelligence," presented at the 15th International Conference on Computer Science & Education (ICCSE) https://doi.org/10.1109/ICCSE49874.2020.9201652, 2020.
[22] M. Kushnir, C. Tokmyanina, and O. Ukolova, "Research of teaching practice by a teacher during post-course support," *The Bulletin of the Karaganda University*, vol. 3, no. 115, pp. 178-191, 2024. https://doi.org/10.31489/2024ped3/178-191
[23] G. Emmanuelle and F. Restrepo and Claudia, "Supporting teachers and students through a smart integrated system for truly inclusive higher education: Smart integrated system for truly inclusive higher education," presented at the In 10th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion (DSAI 2022), August 31-September 02, 2022, Lisbon, Portugal. ACM, New York, NY, USA, 10 Pages. https://doi.org/10.1145/3563137.3563173 2022.
[24] S. Gupta and Y. Chen, "Supporting inclusive learning using chatbots? A chatbot-led interview study," *Journal of Information Systems Education*, vol. 33, no. 1, pp. 98-108, 2022.
[25] D. R. Thomas, S. Gupta, E. Gatz, C. Tipper, and K. R. Koedinger, "So you want to be a tutor? Professional development and scenario-based training for adult tutors," presented at the In The Learning Ideas Conference (pp. 537-547). Cham: Springer Nature Switzerland, 2023.
[26] U. C. Apoki, A. M. A. Hussein, H. K. M. Al-Chalabi, C. Badica, and M. L. Mocanu, "The role of pedagogical agents in personalised adaptive learning: A review," *Sustainability*, vol. 14, no. 11, p. 6442, 2022. https://doi.org/10.3390/su14116442
[27] Y. Kim, A. L. Baylor, and P. Group, "Pedagogical agents as learning companions: The role of agent competency and type of interaction," *Educational technology research and development*, vol. 54, pp. 223-243, 2006. https://doi.org/10.1007/s11423-006-8805-z
[28] I. U. Haq, A. Anwar, I. Basharat, and K. Sultan, "Intelligent tutoring supported collaborative learning (itscl): A hybrid framework," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 8, 2020. https://doi.org/10.14569/IJACSA.2020.0110866
[29] C.-B. Yao and Y.-L. Wu, "Intelligent and interactive chatbot based on the recommendation mechanism to reach personalized learning," *International Journal of Information and Communication Technology Education*, vol. 18, no. 1, pp. 1-23, 2022. https://doi.org/10.4018/IJICTE.315596
[30] V. Slavov, K. Yotovska, and A. Asenova, "Research on the attitudes of high school students for the application of artificial intelligence in education international association for development of the information society," presented at the International

Association for Development of the Information Society (IADIS) International Conferences on e-Society (ES 2023, 21st) and Mobile Learning (ML 2023, 19th) (Lisbon, Portugal, Mar 11-13, 2023) https://inlnk.ru/Jjv1w0, 2023.

[31] U.S. Patent No. US11790798B2, "Online proctoring system," United States Patent and Trademark Office. https://patents.google.com/patent/US11790798B2 2023.

[32] China Patent No. CN110313153B, "Intelligent digital assistants," China National Intellectual Property Administration. https://patents.google.com/patent/CN110313153B, 2022.

[33] China Patent No. CN110148318B, "Teaching assistant digital system, information interaction method, and information processing method," China National Intellectual Property Administration. https://patents.google.com/patent/CN110148318B 2021.

[34] A. Murzalinova, Z. Makatova, L. Almagambetova, A. Imanova, and A. Zeinelova, "Designing the professional development of teachers in Kazakhstan based on the concepts of pedagogical design," *The Bulletin of the Academy of Sciences of the Republic of Kazakhstan*, vol. 3, no. 409, pp. 191-211, 2024. https://doi.org/10.32014/2024.2518-1467.762

[35] State Register of Industrial Property Objects of the Republic of Kazakhstan, "State register of industrial property objects of the republic of Kazakhstan," Retrieved: https://gosreestr.kazpatent.kz, n.d.