IRSTI 14.35.07

10.51889/2959-5894.2024.87.3.026

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THE NECESSITY OF IMPLEMENTING SMART CLASSROOMS IN THE TRAINING OF FUTURE INFORMATICS TEACHERS

Abstract

The article discusses the need to introduce smart classrooms into the educational process and their impact on the training of informatics teachers. Modern trends in educational technologies are analyzed, the importance of smart classrooms as a means of improving the effectiveness of teaching and organizing the learning space is emphasized. Special attention is paid to the training of teachers to work in such conditions, including the necessary qualifications, skills and methodological approaches. The article presents examples of successful practices, as well as discusses the challenges and difficulties that educational institutions may face when integrating smart classrooms. The article also describes an experimental study that substantiates the need to introduce smart classrooms into the educational process of training future informatics teachers.

Keywords: smart classroom, smart technology, informatics teachers, modern education, Internet of thing, control sensors, equipment management automation, system integration.

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НЕОБХОДИМОСТЬ ВНЕДРЕНИЯ SMART АУДИТОРИЙ В СИСТЕМУ ПОДГОТОВКИ БУДУЩИХ УЧИТЕЛЕЙ ИНФОРМАТИКИ

Аннотация

В статье рассматривается необходимость внедрения умных аудиторий в образовательный процесс и их влияние на подготовку учителей информатики. Анализируются современные тенденции в образовательных технологиях, подчеркивается важность умных аудиторий как средства повышения эффективности обучения и организации учебного пространства. Особое внимание уделяется подготовке педагогов к работе в таких условиях, включая необходимую квалификацию, навыки и методические подходы. В статье представлены примеры успешных практик, а также обсуждаются вызовы и трудности, с которыми могут столкнуться образовательные учреждения при интеграции умных аудиторий. В статье также описывается экспериментальное исследование, в котором обоснована необходимость внедрений умных аудиторий в образовательный процесс подготовки будущих учителей информатики.

Ключевые слова: умный класс, интеллектуальные технологии, учителя информатики, современное образование, Интернет вещей, датчики контроля, автоматизация управления оборудованием, системная интеграция.

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БОЛАШАҚ ИНФОРМАТИКА МҰҒАЛІМДЕРІН ДАЯРЛАУ ЖҮЙЕСІНЕ SMART АУДИТОРИЯЛАРДЫ ЕНГІЗУДІҢ ҚАЖЕТТІЛІГІ

Аңдатпа

Мақалада оқу үдерісіне смарт сыныптарды енгізу қажеттілігі және олардың информатика пәні мұғалімдерін даярлауға әсері қарастырылған. Білім беру технологияларының заманауи тенденциялары талданады, оқытудың тиімділігін арттыру және оқу кеңістігін ұйымдастыру құралы ретінде смарт сыныптардың маңыздылығы атап өтілді. Мұғалімдерді смарт сыныптарда жұмыс істеуге, оның ішінде қажетті біліктілік, дағдылар мен әдістемелік тәсілдерді дайындаудың қажеттілігіне ерекше көңіл бөлінеді. Мақалада табысты тәжірибелердің мысалдары келтірілген, сонымен қатар смарт сыныптарды

біріктіру кезінде білім беруде кездесетін мәселелер талқыланады. Сондай-ақ мақалада болашақ информатика мұғалімдерін даярлаудың оқу үдерісіне смарт сыныптарды енгізу қажеттілігін негіздейтін эксперименттік зерттеу сипатталған.

Түйін сөздер: смарт сынып, смарт технология, информатика мұғалімдері, заманауи білім беру, заттардың интернеті, басқару сенсорлары, жабдықты басқаруды автоматтандыру, жүйені біріктіру.

Main provisions

The article substantiates the need to integrate smart classrooms into the training of future informatics teachers, due to the rapid development of technology in education. Smart classrooms equipped with Internet of Things (IoT) technologies create an interactive and adaptive learning environment that significantly improves teaching efficiency and student engagement.

A survey of 286 participants was conducted in order to identify the current state of the use of Smart technologies in the system of training future informatics teachers, assess the impact of «smart» digital tools on the educational process, as well as determine the need to equip educational institutions with Smart classrooms. Many respondents recognize their importance for effective teacher training.

The study highlights the need to prepare future informatics teachers for professional activities in an intellectual learning environment based on IoT.

Note that the introduction of «smart classrooms» is not just a trend, but an important step towards creating a more effective education system. By investing in these technologies, educational institutions can improve the quality of teacher training and better prepare students for the demands of the digital age.

Introduction

In the modern world, the rapid development of technology requires educational institutions to radically change their approaches to the organization of the educational process. One of the most relevant areas is IoT transformation, which provides for the integration of the Internet of Things (IoT) concept into the education. This transformation allows us to create an intelligent ecosystem that combines physical objects such as equipment, educational materials and buildings with digital platforms, which significantly improves the management of educational processes and infrastructure. IoT technologies can significantly increase the level of personalization of education, providing an individual approach to each student's learning, as well as promote more efficient use of resources and improve interaction between all participants in the educational process.

Traditional teaching methods no longer fully meet the challenges of the time, the main problem is that modern educational institutions are not equipped enough to meet new requirements. In this context, smart classrooms are becoming an important alternative as they are lecture halls and classrooms technologically enhanced to support advanced teaching and learning practices. Thanks to the integration of computer, multimedia and network technologies, as well as the use of the Internet of Things (IoT), such classes can significantly improve the learning process, providing access to knowledge at any time and from any place.

Researches [1, [2]] shows that the use of SMART technology in the educational process contributes not only to increased flexibility, but also to improving student academic performance. These technologies, as part of the broader concept of the Internet of Things (IoT), demonstrate the potential for significant improvements in the educational environment. In the context of the rapid development of digital technologies and changing requirements for the educational process, the need for IoT transformation of educational institutions is becoming more and more obvious. Traditional methods of teaching and learning process management no longer fully meet the challenges of the time, which makes the introduction of IoT an important step towards creating a more effective and adaptive educational environment.

The necessity of IoT-driven transformation in educational institutions is becoming more apparent as digital technologies advance rapidly and educational demands change. Traditional methods of teaching and learning process management no longer fully meet the challenges of the time, which

makes the introduction of the Internet of Things (IoT) an important step towards creating a more effective and adaptive educational environment. *First,* IoT allows you to significantly improve the management of the educational institution's infrastructure. Intelligent building monitoring and management systems can automatically adjust lighting, heating and ventilation depending on the presence of people in classrooms, which reduces energy consumption and increases the comfort of students and teachers. In addition, such systems can monitor the condition of equipment and prevent its breakdowns, which minimizes downtime and increases the service life of resources. *Secondly,* the IoT transformation opens up new opportunities for the personalization of the educational process. With the help of connected devices and sensors, it is possible to collect data on the progress of each student, analyze them and offer individual learning recommendations. This contributes to deeper learning of the material and improved academic results. *Thirdly,* IoT contributes to the creation of an interactive and flexible educational environment. The interaction between students and teachers can be improved through the use of smart devices that allow you to organize distance learning, conduct virtual laboratory work and create digital learning materials available at any time.

Thus, the IoT transformation of educational institutions is not just a trend, but a necessity to create a more efficient, flexible and personalized education system that meets the modern requirements of the digital age. The introduction of these technologies will allow classrooms to become smart, and educational institutions will not only improve the quality of education, but also prepare students for successful work in a rapidly changing world.

The transformation of the education system indicates a gradual transition from traditional classroom and e-learning, which was mainly used as an auxiliary tool for people with disabilities, to smart education. The concept of smart education is aimed at providing a high level of educational services, which allows graduates, especially colleges and universities, not only to successfully realize themselves in a rapidly changing professional environment, but also to effectively adapt to the requirements of an innovative society. The experience of countries actively implementing smart technologies demonstrates that the implementation of this concept contributes to the training of highly qualified specialists in high-tech fields.

The modern education system is facing a number of challenges related to the rapid development of digital technologies. Digitalization has affected all aspects of the educational process, changing not only the ways of knowledge transfer, but also the very role of the teacher. In the context of digital transformation, schools and universities are forced to adapt to new requirements by introducing smart technologies, online learning, as well as means of automating the educational process. This changes the expectations of teachers, especially informatics teachers, who become not just knowledge guides, but also mentors in the development of digital competencies.

An informatics teacher in the modern world should not only understand technological trends, but also be able to apply them in teaching. The most important tasks are training in programming, big data skills, cybersecurity and robotics. This requires new approaches in teacher training, including the active use of information technology, IoT devices, as well as the introduction of interactive and personalized educational methods. Without these skills, modern teachers will not be able to effectively prepare students for the challenges of the future. And the lack of modern technologies in classrooms limits the possibility of introducing innovative teaching methods.

The purpose of this article is to substantiate the need to introduce smart classrooms into the system of training future informatics teachers to improve their professional competencies in the field of IoT.

Improving the professional competencies of informatics teachers in the field of IoT (Internet of Things) is extremely important, as these technologies are becoming key in the educational and technological fields. Informatics teachers must have up-to-date knowledge and trends in order to effectively prepare students for modern challenges. Competencies at Riot require an understanding of programming, sensor work, data processing and networking technologies, which allows teachers to implement advanced teaching methods. These skills are especially useful when organizing scientific projects in programming and robotics, where IoT technologies play a key role. For students, such projects become an important step in mastering in-demand skills, and for teachers it is an

opportunity to remain competitive, meeting the requirements of the education market and scientific and technological development. The integration of IoT into the educational process, including Smart classrooms, also improves the quality of teaching, making learning more interactive and adaptive.

Smart learning environments are described as physical spaces enriched with digital, context-aware and adaptive devices that promote more effective and faster learning [3]. In modern conditions, the use of smart classrooms ensures the continuity of the educational process and the organization of distance learning at a high level. One of the basic principles of organizing a smart classroom is flexibility and adaptability [4]. The introduction of smart technologies in higher education significantly affects the academic and social life of students. The success of using these technologies depends on the learning styles and preferences of the students. The key factors for the successful implementation of smart education are student attitudes and environmental characteristics. Changing attitudes and behaviors in the educational sector of the education sector is considered as a critical factor for achieving the successful implementation of smart classes [5]. Many scientists believe that smart learning environments, enriched with digital, context-aware and adaptive devices, provide more effective and faster learning. They not only modernize the traditional educational model, but also open up new opportunities for a personalized approach to each student. In such conditions, students can receive information that suits their individual needs and teaching methods, which contributes to better assimilation of the material and increases motivation to study.

In the studies of foreign scientists, it was noted that their competent application allows [6, 7, 8]:

1) to the teacher: to increase the effectiveness and efficiency of training; to build an individual educational trajectory for each student; to develop independence, engagement, motivation among students; to support independent research of students; to involve students in active joint activities; to improve problem solving, information assimilation; to accelerate the pace of material development, to cover more topics, content; – to reduce anxiety among students;

2) for students: to acquire a richer set of skills; to increase motivation, activity; to develop self-learning skills, ingenuity, strategy; to improve their learning outcomes; to lighten the learning load, etc.

Within the framework of this study, based on the analysis of existing scientific works [9, 10, 11] in the field of creation and functioning of a SMART audience, the principles of effective organization of training in such an audience are highlighted:

- Heterogeneity. The educational environment should include a variety of approaches and teaching methods suitable for different types of students and educational purposes.
- Cross-platform. The use of educational technologies and tools that work on different platforms and devices, ensuring accessibility and compatibility.
- Object orientation. Focusing on the use of educational resources and technologies focused on specific educational facilities and goals, which allows for more accurate adaptation of learning.
- Selection and unification of content. It is important to select and systematize educational content so that it is relevant, consistent and suitable for solving specific educational tasks.
- Methodological study. Ensuring careful study of the methods and approaches used in the educational process to achieve maximum learning effectiveness.
- Using up-to-date data. Integrating real-time data into educational programs to prepare students for practical tasks and real-world conditions.
- Independent cognitive and project activities. Stimulating independent search for solutions, research and project activities for the development of critical thinking and creative approach skills.
- Distributed educational environment. Education should take place not only in traditional educational institutions, but also in a professional environment, providing continuous learning using modern technologies.
- Interaction with the professional community. Active involvement of students in professional communities and a real professional process to acquire practical skills and experience.

- Flexibility and individualization of learning. Providing students with the opportunity to choose individual educational trajectories and adapt learning to their personal needs and interests.

These principles play a key role in creating a modern intellectual educational environment. Their implementation in practice will ensure effective training of future informatics teachers in the field of IoT. Despite the importance of this aspect, existing research mainly focuses on general issues of smart classroom design and implementation, such as technical aspects, pedagogical benefits and impact on students, and there is not enough research on teacher training in the field of IoT.

In particular, the issues of using smart technologies in the classroom remain insufficiently covered, and the issues of developing specific practical skills necessary for informatics teachers to create and use IoT devices, and to work with learning process management systems and other components of smart classrooms are rarely considered.

Research methodology

To substantiate the need to design and implement Smart classrooms in the informatics teacher training system, empirical research based on data collection, study and analysis of scientific literature related to the introduction of Smart classrooms into the educational process were used.

As part of the empirical part of the study, a survey was conducted among 286 respondents: practicing and future informatics teachers, teachers of pedagogical universities, parents of students, graduates, administrators of educational institutions, IT specialists in the field of education. The data was collected using an online questionnaire and covered the following aspects:

- The current level of use of Smart technologies in computer science education.
- The impact of "smart" digital tools on the process of training future teachers.
- Assessment of the need to equip educational institutions with Smart classrooms. The surveys were anonymous and conducted among representatives of different regions, which allowed us to take into account the diversity of experiences and opinions. The data were processed using statistical analysis techniques to identify key trends and needs.

As part of the theoretical study, the analysis of literary sources on the topic was carried out. The study of the impact of Smart education on the training of informatics teachers was conducted according to the following criteria: publications of the last 10 years concerning the introduction of IoT and Smart technologies in education; articles on the methodology of teaching informatics and the development of digital competencies of teachers; peer-reviewed works with theoretical reviews and practical cases of Smart technologies.

Digitalization has a profound impact on education, transforming both teaching methods and the role of the teacher. Modern technologies make it possible to create interactive and adaptive learning materials, which contributes to more effective learning and the development of digital competencies among students. Informatics teachers must master new tools and techniques in order to meet the requirements of the digital age and successfully use the capabilities of modern technologies in the educational process.

However, traditional methods of teacher training are often insufficient to meet modern challenges, as they are based on outdated approaches that do not take into account rapid changes in technology and educational practices. For effective training of informatics teachers, it is necessary to integrate modern digital technologies and teaching methods into their training system. In this context, smart classrooms play a key role by providing flexibility and adaptability that help respond to challenges such as the transition to online learning and the need for an individualized approach. They contribute to the creation of an interactive and dynamic learning environment where future teachers can master and apply modern technologies in real conditions.

A smart classroom is a high-tech learning space equipped with digital tools (interactive panels, computers, video conferencing systems, IoT), providing interactive learning, automated monitoring and analysis of the educational process, as well as personalization of learning, which contributes to increased efficiency and interaction between teachers and students.

Smart technologies support the high quality of the educational process by integrating digital resources, interactive tasks and automated feedback. This allows future informatics teachers to better prepare for real-world practice, developing the skills necessary for effective teaching and preparing students for life in the digital world. The introduction of such technologies also has a positive impact on the academic and social life of students, developing their skills of independent and critical thinking. However, the success of using smart classrooms depends on the attitude of students, their level of digital literacy and the characteristics of the educational environment.

Smart classrooms are an integrated educational environment equipped with advanced digital technologies and interactive tools, which significantly improves the training of future informatics teachers. They contribute to creating a more dynamic and interactive learning environment where students can actively interact with learning materials and receive immediate feedback. Equipping classrooms with IoT technologies and devices allows you to create an intelligent and adaptive educational environment that further improves the learning process. In this context, it is worth considering the list of IoT technologies and devices that can be useful for equipping classrooms:

1. Interactive whiteboards and panels combined into a single system with the workplace of a teacher and a student – allow teachers not only to demonstrate educational material, make annotations in real time, but also ensure the interaction of all participants in the educational process with each other using a touchscreen.

2. Smart projectors are devices that can connect to various devices via Wi-Fi and support interactive features such as annotations and content management from mobile devices.

3. Motion and presence sensors – automatically turn on or off lighting and other systems depending on the presence of people in the classroom, saving energy.

4. Lighting control systems are intelligent systems that adjust the level of illumination depending on lighting conditions and activities.

5. Climate control systems (HVAC) are smart systems that automatically regulate temperature and ventilation depending on the number of people in the classroom and the external conditions.

6. Video conferencing systems are devices and software that allow remote classes and conferences to be held while maintaining high – quality video communication.

7. Smart sockets and switches are devices that allow you to remotely control electrical appliances and control electricity consumption.

8. Voice control systems – Integration with voice assistants such as Amazon Alexa or Google Assistant to control lighting, climate and equipment in the classroom using voice commands.

9. Cloud platforms for content management – software for storing, sharing and managing educational materials, accessible from any device.

10. Mobile devices (tablets, laptops) are devices for students and teachers that provide access to educational materials and interactive applications.

11. 3D printers are devices that allow you to create physical models and prototypes within the framework of educational projects.

12. Automatic curtain/louver control systems – systems that automatically adjust the amount of natural light in the auditorium.

13. E-books and e-readers are devices that provide access to educational materials in electronic form.

14. Smart surveillance cameras integrated with security systems that can analyze and notify about unusual events in the classroom.

15. Touch panels for students – interactive panels or tablets built into students' desks to participate in surveys, tests and collaboration.

16. Sound systems with IoT function – smart speakers and audio systems to ensure high-quality sound and voice notifications in the classroom.

17. Attendance and Activity Data Analysis systems are platforms that collect and analyze data on attendance, student activity and other indicators to improve learning effectiveness.

18. A window and door sensor are the device that registers the opening or closing of windows and doors by sending notifications to a smartphone or a smart home control system. It can be used to increase safety and energy saving, for example, to automatically turn off the heating when the window is open.

19. A smoke detector is a device that detects smoke in a room and sends an audible signal or notification to a mobile device. It is used to prevent fires and increase safety in buildings.

20. A smart door lock is an electronic device that allows you to remotely control the door lock via a smartphone or other Internet-enabled devices. It can open automatically on a signal or provide temporary access to other users.

A possible version of the «smart classroom» scheme and visualization of the main elements of the «smart classroom» in 3D format is shown in Fig.1, 2

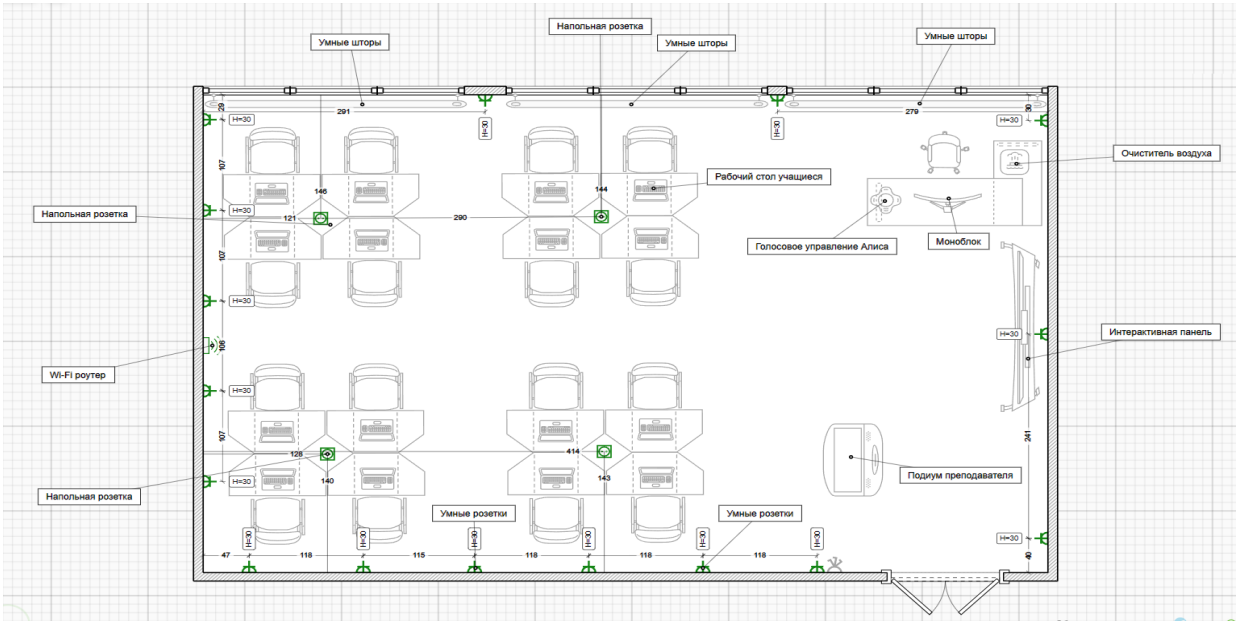

Figure 1. The scheme of the «smart classroom»

Figure 2. Visualization of the main elements of the «smart classroom» in 3D format

Equipping classrooms with such IoT technologies contributes to the creation of a more adaptive and interactive educational environment that supports modern teaching methods and improves the overall quality of the educational process. The successful application of Smart technologies in educational contexts demonstrates their practical value and enriches the understanding of their potential benefits. Here are some examples:

- *Interactive Whiteboards and projectors*. In schools and universities where interactive whiteboards are used, teachers can create more dynamic and engaging lessons. For example, in some schools, informatics teachers use interactive whiteboards to demonstrate real-time programming, which allows students to see the results of their actions immediately.

- *Distance Learning Platforms.* Universities such as MIT and Stanford have successfully implemented online learning platforms that allow students to access courses and materials at any time. These platforms often include elements of gamification and adaptive learning, which increases student motivation.

- *Use of IoT devices.* Some educational institutions have implemented IoT devices for monitoring the educational process. For example, universities can use sensors to track student attendance and classroom activity, allowing teachers to adapt their teaching methods.

- *Mobile Learning apps.* Apps like Kahoot! and Quizlet are actively used in the classroom to create interactive quizzes and tests. These apps allow students to participate in learning in real time, which promotes more active engagement.

- *Virtual and Augmented Reality (VR/AR).* Some educational institutions have started using VR and AR to create immersive learning experiences. For example, in medical schools, VR technology allows students to practice surgical skills in a safe environment, and in historical courses, AR can be used to visualize historical events. Their application in a smart classroom can significantly improve the effectiveness of training future informatics teachers.

- *Adaptive learning systems.* Platforms such as DreamBox and Smart Sparrow use algorithms to adapt learning materials to the individual needs of students. This allows each student to move at their own pace and receive support in areas where they are experiencing difficulties.

- *Learning Management Systems (LMS).* Platforms such as Moodle and Blackboard allow teachers to organize courses, track student progress, and provide access to learning materials. These systems help to create a flexible educational environment where students can study at their convenience.

Results of the study

The study analyzed the questionnaire data collected among 286 respondents representing various categories of participants in the educational process: practicing and future informatics teachers, teachers of pedagogical universities, parents of students, graduates, representatives of the administration of educational institutions and IT specialists in the field of education. The main purpose of the survey was to identify the current state of the use of Smart technologies in the system of training future informatics teachers, to assess the impact of «smart» digital tools on the educational process, as well as to determine the needs for equipping educational institutions with Smart classrooms. This section presents the results of the survey and their discussion aimed at identifying key trends and problems in the use of Smart technologies in education.

The survey was conducted in order to determine the current level of use of Smart technologies in the educational activities of the respondents, where the score ranged from 1 to 5 (from «Very low level» to «Very high level»).

Based on the survey data, the following conclusions can be drawn regarding the current level of Smart technology use among respondents: the majority of respondents (86 people, or about 30%) indicated a «Very low level», suggesting that the implementation of Smart technologies is currently underdeveloped in educational settings, especially among practicing and future teachers; 79 respondents (about 28%) indicated a «Low level». This highlights that nearly half of the respondents (58% in total) use Smart technologies at a minimal level or not at all; 68 respondents (about 24%) rated the level of use as «Medium». This means that some teachers have a basic familiarity and application of Smart technologies, but they are not yet widely used in their practice; only 32 respondents (about 11%) indicated a «High level», and only 21 respondents (about 7%) reported a «Very high level». These data demonstrate that the integration of Smart technologies into the educational process at an advanced level is extremely rare. The current level of Smart technology usage is shown in Fig.3.

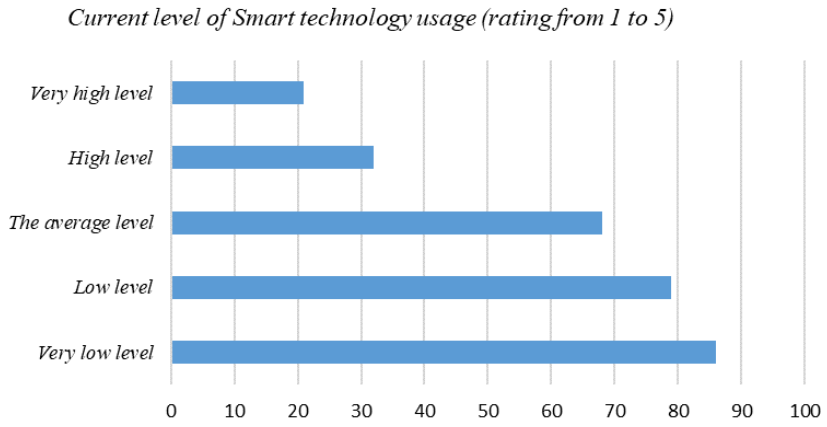

Figure 3. The level of use of Smart technologies

Survey results regarding the impact of smart digital tools on the training of future informatics teachers, as well as respondents' assessment of the need to equip educational institutions with Smart classrooms, revealed the following: a significant majority of respondents indicated a «Significant impact» (25 respondents, 9%) or a «Moderate impact» (78 respondents, 27%). This confirms that digital tools have an important impact on the teacher training process. Weakly influenced: 63 respondents (22%) noted that the impact of these technologies is insignificant, which may indicate insufficient integration of these tools in their practice. It has no impact: only 32 respondents (11%) believe that «smart» tools do not affect the learning process, which demonstrates some skepticism or lack of experience working with these technologies. An extremely significant impact was noted by 88 respondents (31%), which emphasizes that advanced technologies can indeed significantly improve training. The impact of smart digital tools on teacher training is shown in Fig.4.

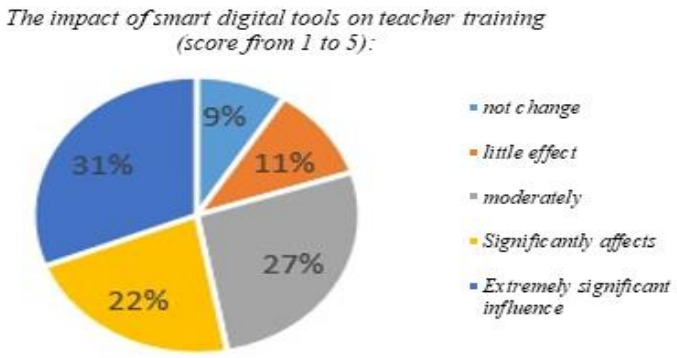

Figure 4. The impact of «smart» digital tools on the training of future computer science teachers

According to the results of the survey on the assessment of the need for Smart classrooms, they showed a high need for Smart classrooms among respondents: 65 respondents (23%) indicated that the presence of Smart classrooms is extremely necessary; 61 people (21%) assessed the need as very high. These data indicate that almost half of the respondents realize the importance of Smart classrooms for the effective training of future informatics teachers, which indicates a desire to modernize the educational process using advanced technologies.

A high need was noted by 59 respondents (21%), and a moderate need was noted by 42 respondents (15%). This indicates that a significant proportion of respondents see the need to use Smart technologies in educational institutions, however, their assessments range from moderate to high levels. 28 respondents (10%) rated the need as low, and 19 people (7%) indicated a very low need. This may indicate that some of the respondents either do not see the immediate benefits of smart

classrooms, or consider their introduction premature. Only 12 respondents (4%) said that smart classrooms are not needed at all. This small percentage demonstrates that there is virtually no resistance to the introduction of such technologies. The assessment of the need for smart classroom is shown in Fig.5.

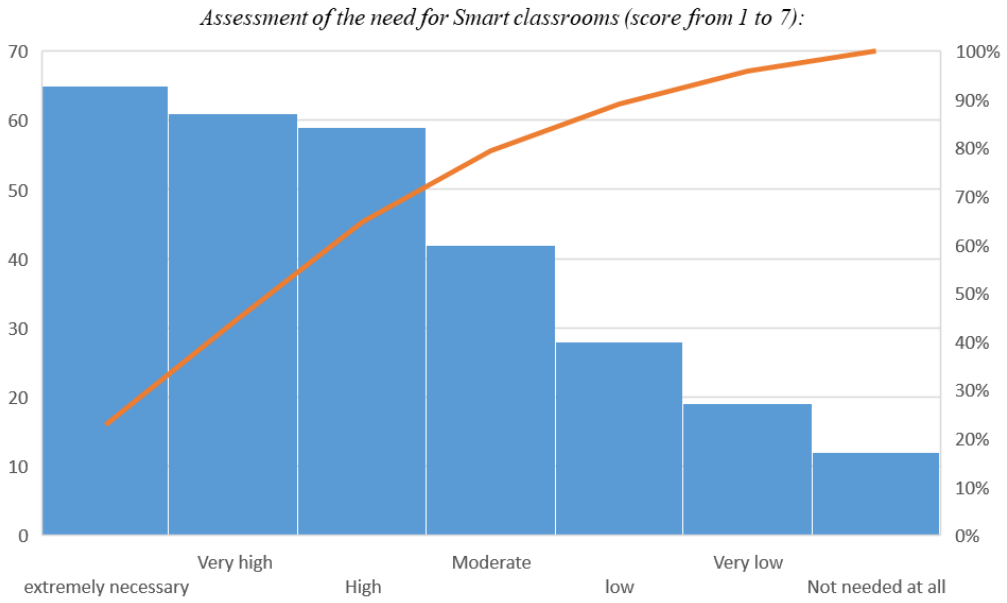

Figure 5. Survey results the need for Smart classrooms

The survey results show that the majority of respondents (about 65%) assess the need for smart classrooms as high or extremely necessary, which underlines the significant interest in the introduction of these technologies into the educational process. The survey also revealed that digital technologies have a significant impact on teacher training and that the level of use of Smart technologies among teachers and future informatics teachers is currently predominantly low. This indicates the urgent need to modernize classrooms and actively implement Smart technologies in order to increase the effectiveness of teaching and technological awareness of teachers.

Discussion

The need to introduce smart classrooms into the system of training future computer science teachers in the context of rapid technology development and changing requirements for the educational process is beyond doubt. They open up new opportunities for personalizing learning, improving the management of educational processes and creating an intelligent learning environment.

Taking into account the results of a survey among 286 potential participants in the educational process, the article offers recommendations. Successful implementation of a Smart classroom requires a comprehensive approach that includes several key factors:

- *Assessment of needs and opportunities*. Before implementing Smart technologies, it is important to analyze the needs of the educational institution and the possibilities for their implementation. This includes an assessment of the technical infrastructure, the level of digital literacy of teachers and students, as well as available resources.
- *Teacher education and training.* It is necessary to organize advanced training courses for teachers so that they can effectively use Smart technologies in the educational process. This may include trainings on working with interactive whiteboards, distance learning platforms, and other tools.
- *Pilot projects.* It is recommended to start with small pilot projects to test the implementation of Smart technologies on a limited scale. This will allow you to identify possible problems and adapt approaches before scaling at the level of the entire educational institution.

- *Integration of technologies into the curriculum.* Smart technologies should be integrated into the curriculum and teaching materials. Teachers should develop assignments and projects that use these technologies so that students can see their practical application.
- *Support from the administration.* It is important that the management of the educational institution supports the introduction of Smart technologies, allocating the necessary resources and creating conditions for their use. This may include financing, technical support and the creation of an innovative culture.
- *Feedback and performance evaluation.* It is necessary to regularly collect feedback from students and teachers on how Smart technologies affect the learning process. This will help to make adjustments and improve approaches to their use.
- *Cooperation with professional communities.* It is important to actively involve students in professional communities and the real professional process. This can be achieved through internships, projects with companies and participation in conferences, which will help students apply their knowledge in practice.
- *Adaptation to changes.* The introduction of Smart technologies requires flexibility and readiness for change. Educational institutions should be ready to adapt their approaches and methods depending on new technologies and the needs of students.
- *Creation of innovative educational spaces.* It is recommended to rethink the physical space of educational institutions by creating flexible and adaptive learning environments that promote interaction and collaboration between students.
- *Using data for decision-making.* The introduction of systems that collect and analyze data about the learning process can help in making informed decisions and improving the quality of education.

Conclusion

In the context of rapid changes in the educational environment and increasing requirements for the qualifications of informatics teachers, the introduction and development of Smart classrooms is becoming a necessary step to improve the quality of teacher training. These innovative educational spaces not only contribute to the creation of a more dynamic and interactive learning environment, but also provide access to modern tools and technologies that become the basis for effective learning.

Smart classrooms provide unique opportunities for adaptive learning, allow the integration of new techniques and approaches, ensure the implementation of practice-oriented tasks and contribute to improving the level of professional training of future informatics teachers. Thanks to the integration of modern information and communication technologies, such classrooms help teachers develop the necessary skills and competencies to successfully carry out their professional activities in a rapidly changing technological landscape.

Thus, Smart classrooms represent not only an innovative approach to the organization of the educational process, but also a key element for the formation of an effective system for training informatics teachers. Their implementation and use contribute to improving the quality of education, increasing the level of digital literacy of teachers and, as a result, more successful adaptation of students to modern requirements of the labor market and the educational environment. Investing in the creation and development of such educational spaces is an important strategy to ensure the high-quality training of competent informatics teachers and ICT specialists for education.

Acknowledgment

The article was prepared with the financial support of the Ministry of Science and Higher Education of the Republic of Kazakhstan within the framework of grant research: No. AP23490844 «IoT Transformation of an Educational Institution: Design, Implementation of Smart Classrooms and Training of Specialists in the Field of IoT for Education».

Список использованных источников

[1] Шарипов Б.Ж.1, Джусубалиева Д.М. SMART-обучение как новый подход в системе высшего образования. Вестник КазНПУ им. Абая, серия «Педагогические науки», №2(66), 2020 г. DOI: 10.51889/2020-2.1728-5496.07

[2] Hoel T. & Mason J. Smart Learn. Environ. (2018) 5:3. DOI: https://doi.org/10.1186/s40561-018-0052-3.

[3] Zakiah, A., Prihatmanto, USA, Mahayana, D.,Andrea, R. The Philosophy of Smart Learning Using the Approach Thomas Kuhn Paradigm Shift International Journal of Information Engineering and Electronic Business,16(1), P. 54–62. 2024. DOI: https://doi.org/10.5815/ijieeb.2024.01.05

[4] Тявловский К. Л., Свистун А. И., Воробей Р. И. [и др.] //Оснащение умной аудитории Приборостроение-2021: Материалы 14-й Международной научно-технической конференции, Минск, 17–19 ноября 2021 года. – Минск: Белорусский национальный технический университет, 2021. – С. 136-138. – EDN EKFOPG. https://www.elibrary.ru/item.asp?id=48993662

[5] Almutairi, Ibtisam L F H, Almutairi, Faisal L F H; Alazemi, Bodoor F Higher Education and Smart Education System: The Impact of Learning Style and Environmental Characteristics in the State of Kuwait International Journal of Interactive Mobile Technologies Том 16, Выпуск 13, Страницы 192 – 1992022 https://doi.org/10.3991/ijim.v16i13.30607

[6] Мироненко Е. С. Задачи и перспективы внедрения смарт-технологий в образовательный процесс // Социальное пространство. 2018. № 1 (13). DOI:10.15838/sa/2018.1.13.5

[7] Нестеров А.В. Приведет ли смарт-образование к «закату» университетов? // Компетентность. 2015. № 2. https://publications.hse.ru/mirror/pubs/share/folder/zhwssq5gj1/direct/168046695?ysclid=m1j9lyzisb361866406

[8] Spector J. M. Smart Learning Environments: Potential and Pitfalls. In: Persichitte K., Suparman A., Spector V. (eds) Educational Technology to Improve Quality and Access on a Global Scale. Educational Communications and Technology: Issues and Innovations. Springer, Chan. Pp. 33–42. DOI: https://doi.org/10.1007/978-3-319-66227-5_4

[9] Григорьев, С. Г., Гриншкун, В. В., & Реморенко, И. М. (2013). "Умная аудитория" в Институте математики и информатики МГПУ: теория и практика. Вестник Московского городского педагогического университета. Серия: Информатика и информатизация образования, (2 (26)), 8-18. https://cyberleninka.ru/article/n/umnaya-auditoriya-v-institute-matematiki-i-informatiki-mgpu-teoriya-i-praktika/viewer. Дата обр. 10.08.2024.

[10] Тихомиров Владимир Павлович, & Днепровская Наталья Витальевна (2015). Смарт-образование как основная парадигма развития информационного общества. Современные информационные технологии и ИТ-образование, 1 (11), 9-13.

[11] Мосиенко, Л. В. Смарт-технологии в обучении иностранным языкам: цели, принципы, характеристики, классификации / Л. В. Мосиенко // Современное общее образование : проблемы, инновации, перспективы : Материалы международной научно-практической конференции, Орел, 25 февраля 2022 г. – С. 470-479. EDN NSZQJI. https://www.elibrary.ru/item.asp?id=49749810&ysclid=m1j92jw5u1439546436

References

[1] Sharipov B.Zh.1 , Dzhusubalieva D.M. (2020) SMART-obuchenie kak novyj podhod v sisteme vysshego obrazovanija. [SMART learning as a new approach in the higher education system.] VESTNIK KazNPU im. Abaja, serija «Pedagogicheskie nauki», №2(66). DOI: 10.51889/2020-2.1728-5496.07 (in Russian)

[2] Hoel T. & Mason J. (2018) Smart Learn. Environ. 5:3. DOI: https://doi.org/10.1186/s40561-018-0052-3.

[3] Zakiah, A., Prihatmanto, USA, Mahayana, D.,Andrea, R. The Philosophy of Smart Learning Using the Approach Thomas Kuhn Paradigm Shift International Journal of Information Engineering and Electronic Business,16(1), P. 54–62. 2024. DOI: https://doi.org/10.5815/ijieeb.2024.01.05

[4] K. L. Tjavlovskij, A. I. Svistun, R. I. Vorobej [i dr.] (2021) Osnashhenie umnoj auditorii [Equipping a smart audience]. Priborostroenie-2021: Materialy 14-j Mezhdunarodnoj nauchno-tehnicheskoj konferencii, Minsk, 17–19 nojabrja. – Minsk: Belorusskij nacional'nyj tehnicheskij universitet. – S. 136-138. – EDN EKFOPG. https://www.elibrary.ru/item.asp?id=48993662 (in Russian)

[5] Almutairi, Ibtisam L F H, Almutairi, Faisal L F H; Alazemi, Bodoor F Higher Education and Smart Education System: The Impact of Learning Style and Environmental Characteristics in the State of Kuwait International Journal of Interactive Mobile Technologies Tom 16, Vypusk 13, Stranicy 192 – 1992022 https://doi.org/10.3991/ijim.v16i13.30607

[6] Mironenko E. S. (2018) Zadachi i perspektivy vnedrenija smart-tehnologij v obrazovatel'nyj process [Tasks and prospects of introducing smart technologies into the educational process]. Social'noe prostranstvo. № 1 (13). DOI:10.15838/sa/2018.1.13.5 (in Russian)

[7] Nesterov A.V. (2015) Privedet li smart-obrazovanie k «zakatu» universitetov? [Will smart education lead to the "decline" of universities?]. Kompetentnost'. № 2. https://publications.hse.ru/ mirror/pubs/share/folder/zhwssq5gj1/direct/168046695?ysclid=m1j9lyzisb361866406 (in Russian)

[8] Spector J. M. (2017) Smart Learning Environments: Potential and Pitfalls. In: Persichitte K., Suparman A., Spector V. (eds) Educational Technology to Improve Quality and Access on a Global Scale. Educational Communications and Technology: Issues and Innovations. Springer, Chan. Pp. 33–42. DOI: https://doi.org/10.1007/978-3-319-66227-5_4

[9] Grigor'ev, S. G., Grinshkun, V. V., & Remorenko, I. M. (2013). "Umnaja auditorija" v Institute matematiki i informatiki MGPU: teorija i praktika. ["Smart audience" at the Institute of Mathematics and Computer Science of the Moscow State Pedagogical University: theory and practice]. Vestnik Moskovskogo gorodskogo pedagogicheskogo universiteta. Serija: Informatika i informatizacija obrazovanija, (2 (26)), 8-18. Data obr. 10.08.2024. https://cyberleninka.ru/article/n/umnaya-auditoriya-v-institute-matematiki-i-informatiki-mgpu-teoriya-i-praktika/viewer. (in Russian)

[10] Tihomirov Vladimir Pavlovich, & Dneprovskaja Natal'ja Vital'evna (2015). Smart-obrazovanie kak osnovnaja paradigma razvitija informacionnogo obshhestva.[Smart education as the main paradigm of information society development]. Sovremennye informacionnye tehnologii i IT-obrazovanie, 1 (11), 9-13. (in Russian)

[11] Mosienko, L.V. (2020) Smart-tehnologii v obuchenii inostrannym jazykam: celi, principy, harakteristiki, klassifikacii [Smart technologies in teaching foreign languages: goals, principles, characteristics, classifications]. L.V. Mosienko // Sovremennoe obshhee obrazovanie : problemy, innovacii, perspektivy: Materialy mezhdunarodnoj nauchno-prakticheskoj konferencii, Orel, 25 fevralja. – S. 470-479. – EDN NSZQJI. https://www.elibrary.ru/item.asp?id=49749810&ysclid=m1j92jw5u1439546436 (in Russian)