IMPROVEMENT INFORMATION AND DIGITAL COMPETENCE TEACHERS IN THE CONDITIONS OF DIGITALIZATION OF EDUCATION

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Abstract. Digital educational technologies occupy an increasingly important place among others educational technologies. Thanks to their improvement, effective training is possible remote and mixed forms, which have become predominant since the beginning of the quarantine due to the COVID-19 pandemic. Modern teachers are tasked with constantly improving their digital skills educational technologies. This is also stated in the Teacher's Professional Standard through revealing the content of the teacher's information and digital competence. Process learning can be made more interesting, varied and intensive due to combining a regular lesson with a computer, tablet or other gadget. It will allow the teacher to transfer part of his work to the gadget. The teacher can speed up the writing of definitions, theorems, and other important parts material, as the teacher does not need to repeat the text several times in this case times (the teacher displayed the text on the screen). And the student of education does not need to wait until the teacher will repeat exactly the fragment he needs. The purpose of the work is to investigate the essence of the digitalization of education, to analyze the current global educational trends and to determine the key directions of digitalization of general secondary education in EU countries and in Ukraine. The main research methods were scientific abstraction, comparative and statistical analyzes, logical generalization, structural-functional and strategic analysis for substantiation and determination of directions of digital development of general secondary education. As a result of research, it will be established that the new concept of the development of the digital economy and society for the coming years assumes that the digitalization of education is a modern stage of its informatization. Digitization of secondary education is formed depending on the trends in the development of digital and IT readiness of society. Building a robust infrastructure for learning begins with an understanding of the goals and desired outcomes that support engaging and empowering learning experiences. When based on learning goals, technology infrastructure decisions become clear. The use of digital technologies is necessary to ensure the educational needs of all participants in the educational process.

Keywords: digitization, secondary education, artificial intelligence, learning outcomes, Internet, educational management.

Today, the possession of digital competences is mandatory in order to be successful in the digital society. Now the government and business have realized the need to develop measures to adapt to new realities [1]. Most modern professions today require the ability not only to communicate and collaborate with the help of gadgets, but also to process large data sets, critically evaluate information found on the Internet and other media, understand the needs of cyber security, and be able to program and manage "smart things". There is a high probability that in 5 years' society will have an acute problem of shortage of personnel who will have the necessary professional competences, including digital ones.

Digitization of education becomes an important component of the transformation of secondary education, one of the main tasks of the development of the information society. The concept of the development of the digital economy and society for the coming years assumes that the digitalization of education is a modern stage of its informatization. Saturation of the educational environment with digital devices, innovative means of learning, coverage with a high-quality Internet network will form a high-quality educational space. Digitization of secondary education is formed depending on the trends in the development of digital and IT readiness of society.

Researchers of education transformation problems pay considerable attention to the study of the formation of the state educational policy and directions of its development, part of which is the educational policy in the field of using digital technologies.

One of the steps in solving the problem of digitization of education can be considered the application of tools for comprehensive assessment of the level of digital readiness of an educational institution. According to the procedure of conducting an institutional audit in institutions of general secondary education, in accordance with the approved criteria and indicators, the educational and management processes of the educational institution and the internal system of ensuring the quality of education are assessed. Among the proposed criteria, three are highlighted that relate to the use of digital technologies (Figure 2.9).
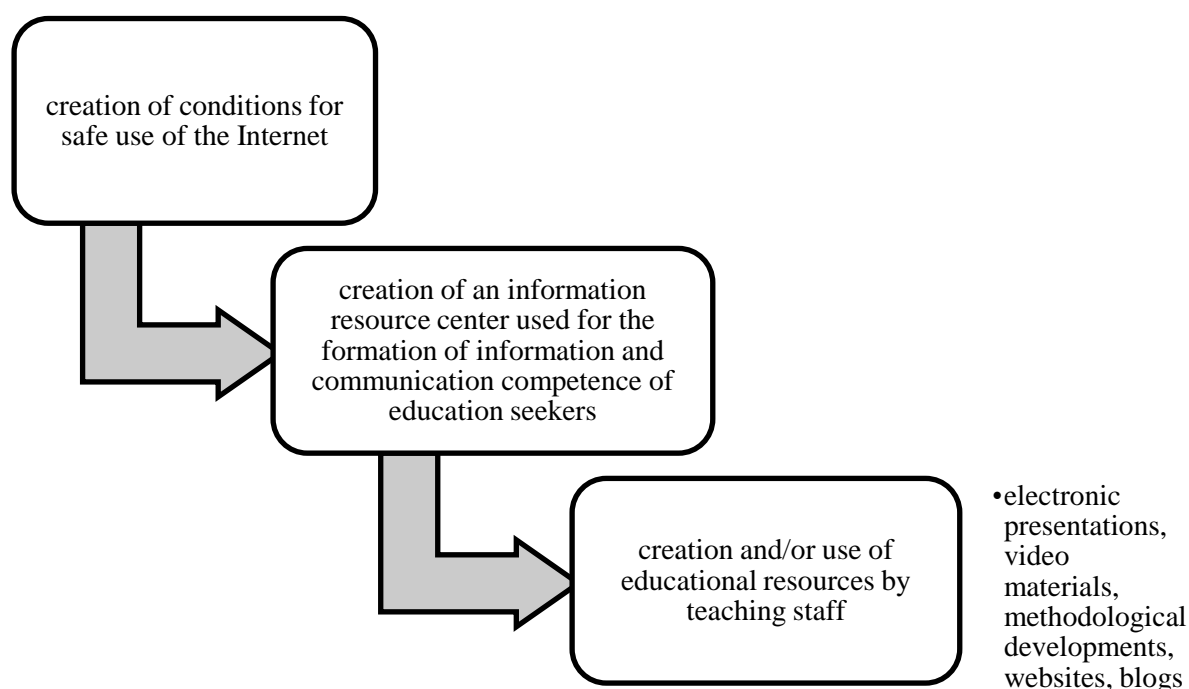
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Figure 2.9. Criteria for digitalization of secondary education features [2]

At the same time, to determine the indicators of the internal system of ensuring the quality of education in an educational institution, a special tool should be developed that would allow avoiding subjective evaluation. It is obvious that such a tool should be one of the existing digital tools, the access to which is simplified and which allows a comprehensive assessment of the real state of affairs and allows the development of a strategic plan for the development of an educational institution and the determination of its educational policy, which includes its digitalization.

Such tools already exist in the world. For example, Australian National ICT Literacy [3], COMDID [4], ETS iCritical Thinking, NAEP [3], SELFIE [5].

At the heart of digital transformations are digital trends – directions in the development of digital technologies. The analysis of digital trends makes it possible to predict the development of specific economic, technological and even social phenomena in the future [6].

Drawing from Huawei's own quantitative data and real-world use cases of how intelligent technology is permeating every industry, this year's report identifies 10 megatrends currently shaping how we live and work. GIV also predicts technology

trends up until 2025, including 5G coverage, AI deployment, home robot adoption, and smart assistant use rates [7].

The 10 trends and examples of GIV's key predictions for 2025 are as follows (Table 2.6).

Table 2.6. The ten intelligent technology megatrends for 2025 [7]

Megatrends	Characteristics of the trends
1. Living with Bots	Advances in material science, perceptual AI, and network technologies are powering the uptake of robotics in a variety of home and personal scenarios. GIV predicts a 14% global penetration rate of home robots.
2. Super Sight	The convergence of 5G, VR/AR, machine learning, and other emerging technologies will let us see beyond distance, distortion, surface, and history, opening up new vistas for people, business, and culture. GIV predicts that the percentage of companies using AR/VR will increase to 10%.
3. Zero Search	As data-driven and sensor-equipped appliances and devices begin anticipating our needs, information will find us. Future searches will be button-free, personal social networks will be created effortlessly, and industry will benefit from "zero-search maintenance". GIV predicts that 90% of smart device owners will use intelligent personal assistants.
4. Tailored Streets	Intelligent transport systems will connect people, vehicles, and infrastructure, creating zero congestion, rapid emergency response, and other functions that will make life smoother. GIV predicts that 15% of vehicles will have Cellular Vehicle-to-Everything technology.
5. Working with Bots	Already transforming many industries, smart automation will take on more hazardous, repetitive, and high-precision tasks – a boon for safety and productivity. GIV predicts that there will be 103 robots in industry for every 10,000 employees.
6. Augmented Creativity	Cloud AI will cut the cost and barrier of entry to scientific experimentation, innovation, and art, opening up a goldmine of creative potential that's available to all. GIV predicts that 97% of large companies will have deployed AI.
7. Frictionless Communication	AI and big data analytics will create seamless communication between companies and customers and break down language barriers. Accuracy, understanding, and trust will underpin tomorrow's communications. GIV predicts that enterprises will fully use of 86% of the data that they produce.
8. Symbiotic Economy	Companies across the planet are adopting digital tech and smart applications on unified access platforms – that means greater collaboration, resource-sharing, stronger global ecosystems, and higher productivity. GIV predicts that every company everywhere will be using cloud technology and 85% of business applications will be cloud-based
9. 5G's rapid rollout	5G is here and it's landing far faster than any previous wireless generation – the potential for individuals, businesses, and society is enormous. GIV predicts that 58% of the world's population will have access to 5G.
10. Global Digital Governance	Advancements in digital tech must be balanced by shared data standards and principles for data use. GIV predicts that the annual volume of global data will reach 180 ZB (1 ZB = 1 trillion GB).

According to the CMO of Huawei ICT Infrastructure Kevin Zhang, "Human exploration will never stop. We should set our sights beyond what we see now and look to the future, shifting from innovation to invention. We're seeing rapid changes

to life, work, and society as every industry adopts AI, 5G, cloud computing, and other emerging technologies. Huawei is committed to building digital platforms, user experiences, and intelligent technology that power ubiquitous connectivity in every scenario. It's our mission to offer every person, home, and organization an intelligent future and the benefits of entirely new opportunities for growth" [7].

Under such conditions, society and education must be transformed and oriented towards the future, train specialists who will turn innovations into inventions, and, therefore, produce a transformation of the educational environment, which in turn will ensure a comprehensive, competent and modern approach to the secondary education system.

The use of digital technologies is necessary to ensure the educational needs of all participants in the educational process, sustainable socio-economic development of educational institutions and the country as a whole. Today, citizens' digital abilities and skills are not just means of improving the life of society, but the main products of the country's economic activity. Moreover, these skills are the main resources of the information society, which directly affect the economic well-being and social development of the state. Digital technologies serve as a tool for access to continuous learning, which is necessary for the successful involvement of all population groups in the information society.

Digital literacy and information culture have become the key to a person's successful professional activity. The more attention is paid to this issue in secondary education institutions, the more effectively students will be able to use modern tools for obtaining information data and transforming them into knowledge.

Transforming secondary education is not a quick and easy process. This stage requires the deep interest and collaboration of all participants in the process: educators, parents, public leaders and business representatives. The components of this process are the mechanisms of adaptation to the changing needs of students, transparent, flexible and value-oriented educational policy.

Today, the US is a leading country in the digitalization of the education industry and the use of digital technologies for the transformation of learning that defines

future road map for other countries. The National Educational Technology Plan is the flagship educational technology policy document for the United States. The Plan articulates a vision of equity, active use, and collaborative leadership to make everywhere, all-the-time learning possible. While acknowledging the continuing need to provide greater equity of access to technology itself, the plan goes further to call upon all involved in American education to ensure equity of access to transformational learning experiences enabled by technology [8].

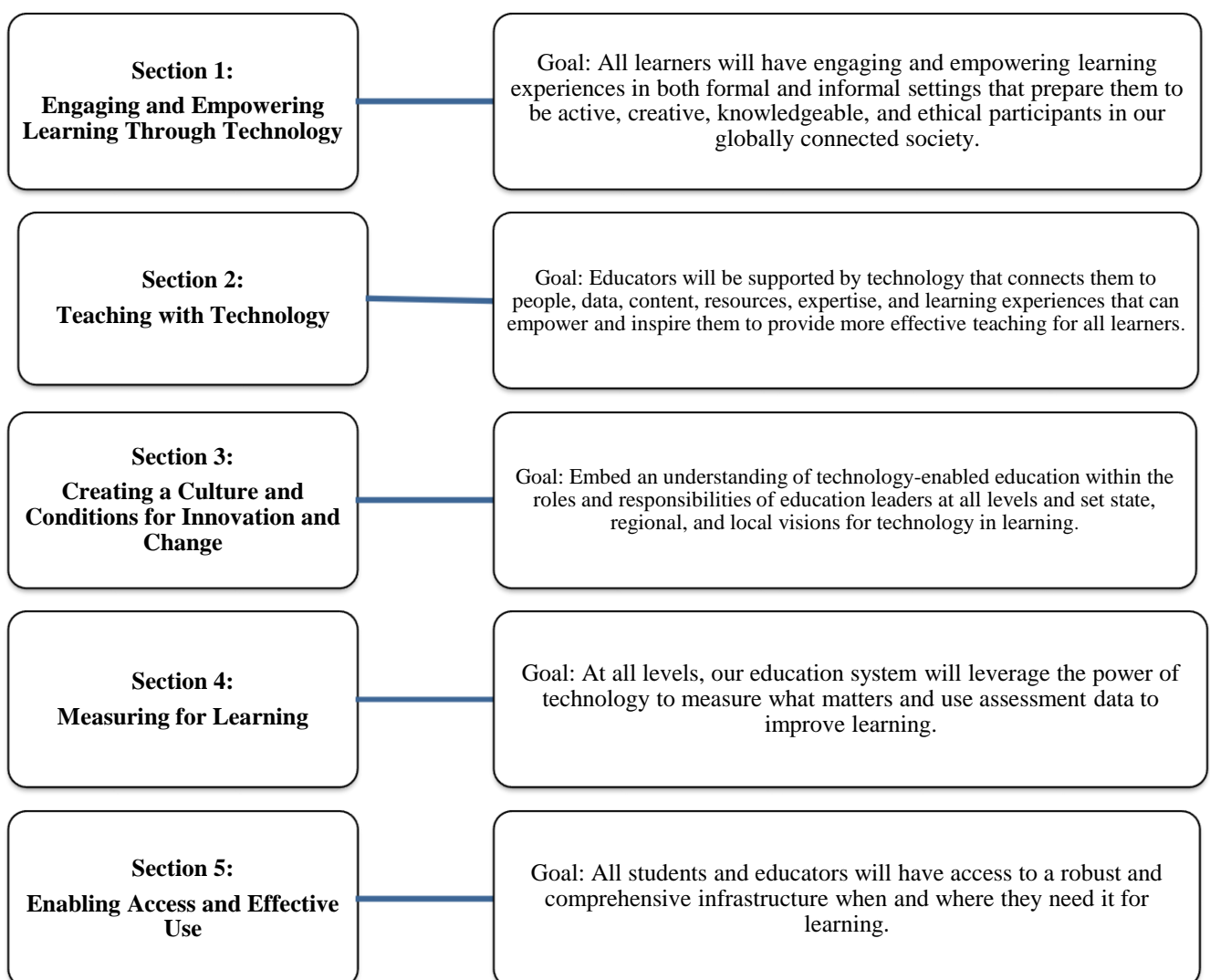The National Educational Technology plan consists of five sections (Figure 2.10):

Section 1: Engaging and Empowering Learning Through Technology	Goal: All learners will have engaging and empowering learning experiences in both formal and informal settings that prepare them to be active, creative, knowledgeable, and ethical participants in our globally connected society.
Section 2: Teaching with Technology	Goal: Educators will be supported by technology that connects them to people, data, content, resources, expertise, and learning experiences that can empower and inspire them to provide more effective teaching for all learners.
Section 3: Creating a Culture and Conditions for Innovation and Change	Goal: Embed an understanding of technology-enabled education within the roles and responsibilities of education leaders at all levels and set state, regional, and local visions for technology in learning.
Section 4: Measuring for Learning	Goal: At all levels, our education system will leverage the power of technology to measure what matters and use assessment data to improve learning.
Section 5: Enabling Access and Effective Use	Goal: All students and educators will have access to a robust and comprehensive infrastructure when and where they need it for learning.

Figure 2.10. Structural division of National Educational Technology plan [8]

Section 1. To be successful in our daily lives and in a global workforce, Americans need pathways to acquire expertise and form meaningful connections to peers and mentors. This journey begins with a base of knowledge and abilities that can be augmented and enhanced throughout our lives. Fortunately, advances in learning sciences have provided new insights into how people learn. Technology can be a powerful tool to reimagine learning experiences on the basis of those insights.

Historically, a learner's educational opportunities have been limited by the resources found within the walls of a school. Technology-enabled learning allows learners to tap resources and expertise anywhere in the world, starting with their own communities. For example:

- With high-speed Internet access, a student interested in learning computer science can take the course online in a school that lacks the budget or a faculty member with the appropriate skills to teach the course.

- Learners struggling with planning for college and careers can access high-quality online mentoring and advising programs where resources or geography present challenges to obtaining sufficient face-to-face mentoring.

- With mobile data collection tools and online collaboration platforms, students in a remote geographic area studying local phenomena can collaborate with peers doing similar work anywhere in the world.

- A school with connectivity but without robust science facilities can offer its students virtual chemistry, biology, anatomy, and physics labs – offering students learning experiences that approach those of peers with better resources.

- Students engaged in creative writing, music, or media production can publish their work to a broad global audience regardless of where they go to school.

- Technology-enabled learning environments allow less experienced learners to access and participate in specialized communities of practice, graduating to more complex activities and deeper participation as they gain the experience needed to become expert members of the community.

These opportunities expand growth possibilities for all students while affording historically disadvantaged students greater equity of access to high-quality learning

materials, expertise, personalized learning, and tools for planning for future education. Such opportunities also can support increased capacity for educators to create blended learning opportunities for their students, rethinking when, where, and how students complete different components of a learning experience [8].

Section 2. Technology offers the opportunity for teachers to become more collaborative and extend learning beyond the classroom. Educators can create learning communities composed of students; fellow educators in schools, museums, libraries, and after-school programs; experts in various disciplines around the world; members of community organizations; and families. This enhanced collaboration, enabled by technology offers access to instructional materials as well as the resources and tools to create, manage, and assess their quality and usefulness.

To enact this vision, schools need to support teachers in accessing needed technology and in learning how to use it effectively. Institutions responsible for pre-service and in-service professional development for educators should focus explicitly on ensuring all educators are capable of selecting, evaluating, and using appropriate technologies and resources to create experiences that advance student engagement and learning. They also should pay special care to make certain that educators understand the privacy and security concerns associated with technology. This goal cannot be achieved without incorporating technology-based learning into the programs themselves.

For many teacher preparation institutions, state offices of education, and school districts, the transition to technology-enabled preparation and professional development will entail rethinking instructional approaches and techniques, tools, and the skills and expertise of educators who teach in these programs. This rethinking should be based on a deep understanding of the roles and practices of educators in environments in which learning is supported by technology [8].

Section 3. Taking full advantage of technology to transform learning requires strong leadership capable of creating a shared vision of which all members of the community feel a part. Leaders who believe they can delegate the articulation of a vision for how technology can support their learning goals to a chief information

officer or chief technology officer fundamentally misunderstand how technology can impact learning. Technology alone does not transform learning; rather, technology helps enable transformative learning. The vision begins with a discussion of how and why a community wants to transform learning. Once these goals are clear, technology can be used to open new possibilities for accomplishing the vision that would otherwise be out of reach. Moving to learning enabled by technology can mean a shift in the specific skills and competencies required of leaders. Education leaders need personal experience with learning technologies, an understanding of how to deploy these resources effectively, and a community-wide vision for how technology can improve learning [8].

Section 4. Measuring learning is a necessary part of every teacher's work. Teachers need to check for student understanding, and parents, students, and leaders need to know how students are doing overall in order to help them successfully prepare for college and work. In addition to supporting learning across content areas, technology-enabled assessments can help reduce the time, resources, and disruption to learning required for the administration of paper assessments. Assessments delivered using technology also can provide a more complete and nuanced picture of student needs, interests, and abilities than can traditional assessments, allowing educators to personalize learning.

Through embedded assessments, educators can see evidence of students' thinking during the learning process and provide near real-time feedback through learning dashboards so they can take action in the moment. Families can be more informed about what and how their children learned during the school day. In the long term, educators, schools, districts, states, and the nation can use the information to support continuous improvement and innovations in learning.

Continued advances in technology will expand the use of ongoing, formative, and embedded assessments that are less disruptive and more useful for improving learning. These advances also ensure that all students have the best opportunity to demonstrate their knowledge and skills on statewide assessments that increasingly focus on real-world skills and complex demonstrations of understanding. Statewide

assessment – coupled with meaningful accountability – is an essential part of ensuring students have equitable access to high-quality educational experiences. At the same time, it is crucial to focus time and effort on tests worth taking – those that reflect the kind of instructional experiences students need and that provide actionable insight.

As technology gives us the capability to improve on long-standing assessment approaches, our public education system has a responsibility to use the information we collect during assessment in ways that can have the greatest impact on learning. This means using assessments that ask students to demonstrate what they have learned in meaningful ways. And students and parents know there is more to a sound education than picking the right answer on a multiple-choice question or answering an extended-response question outside of the context of students' daily lives. All learners deserve assessments that better reflect what they know and are able to do with that knowledge [8].

Section 5. Preparing students to be successful for the future requires a robust and flexible learning infrastructure capable of supporting new types of engagement and providing ubiquitous access to the technology tools that allow students to create, design, and explore. The essential components of an infrastructure capable of supporting transformational learning experiences include the following:

- *Ubiquitous connectivity.* Persistent access to high-speed Internet in and out of school

- *Powerful learning devices.* Access to mobile devices that connect learners and educators to the vast resources of the Internet and facilitate communication and collaboration

- *High-quality digital learning content.* Digital learning content and tools that can be used to design and deliver engaging and relevant learning experiences

- *Responsible Use Policies (RUPs).* Guidelines to safeguard students and ensure that the infrastructure is used to support learning.

Building a robust infrastructure for learning begins with an understanding of the goals and desired outcomes that support engaging and empowering learning

experiences. When based on learning goals, technology infrastructure decisions become clear.

Educators from all grade-levels are coming to realize the benefits of technology in the classroom. Typically, education is one of the last industries to make extensive change, holding on to antiquated methods and practices. But through the digital transformation and the rise of educational technology, teachers have begun making drastic changes to their instruction, assessments, even the physical make-up of their classrooms, and at a much faster rate than expected. These current trends are making headlines in education because of the ways in which they are impacting student learning (Figure 2.11).
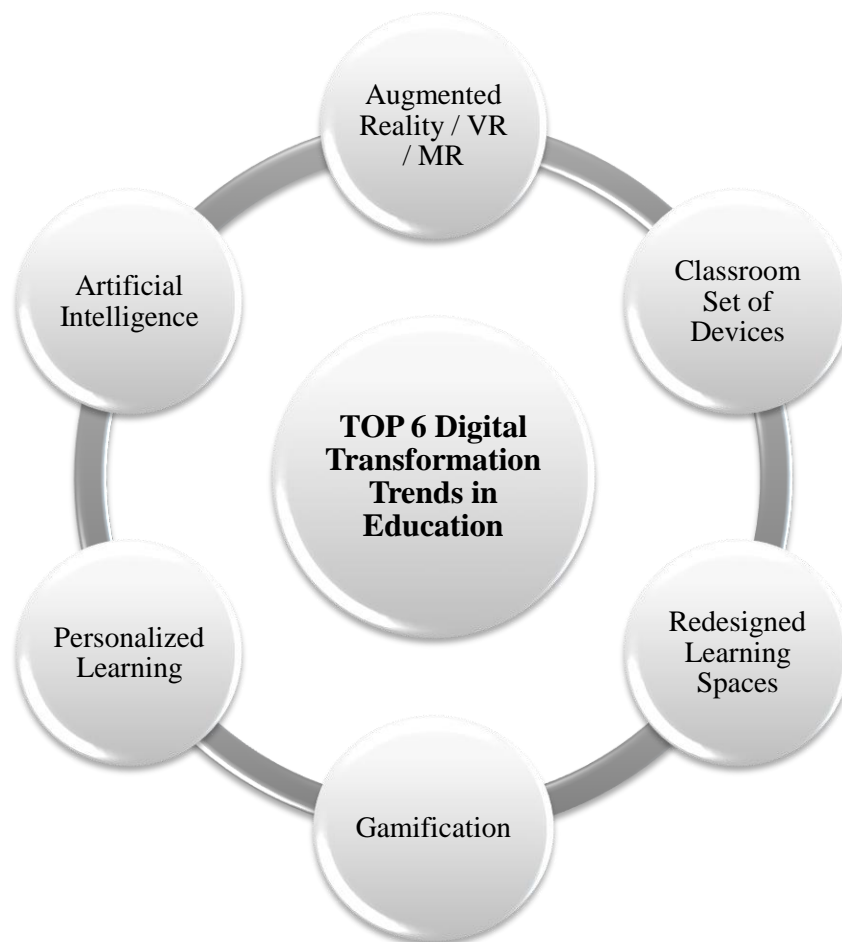

Figure 2.11. The Top 6 trends for Digital transformation in Education [9]

Augmented Reality / Virtual Reality / Mixed Reality. Gone are the days where students are expected to sit quietly at their desks. Educational technology is succeeding in making learning collaborative and interactive. Augmented, virtual, and mixed reality are examples of transformative technology that enhance teacher instruction while simultaneously creating immersive lessons that are fun and engaging for the student. Virtual reality has the capability of bringing the outside world into the classroom and vice versa. Apps such as Unimersiv can transport students to ancient Greece, while Cospaces allows students to share their virtual creations with the world. Wilkes University online adjunct professor and independent educational technologist Kathy Schrock concludes virtual reality has the potential to increase visual literacy, technology literacy, and attention to audience. The idea of combining AR/VR/MR is highly anticipated. Take, for example, the privately owned company Magic Leap. Even though it has yet to really sell anything, Magic Leap is already valued at four and a half billion dollars! This speaks to the projected endless possibilities of technology transforming classrooms.

***Classroom Set of Devices*.** Schools are moving away from BYOD, or bring your own device, and students no longer have to go to the technology lab for access to a computer or laptop. Recent years have shown an increase in classroom sets of computers that was made possible in part by federal funding. Title I schools have received funds via The Every Student Succeeds Act, and several grants and donations have outfitted classrooms all over the country with iPads and laptops for each student. Google Chromebooks account for over half of the devices in US classrooms. In 2014, more than three million Chromebooks were used in educational institutions. As that number continues to grow, so does the need for increased focus on programs that teach digital citizenship skills. Today's pervasive online environment poses exciting possibilities, ones that necessitate students are properly educated on cyber safety and individual responsibility.

Redesigned Learning Spaces. Walk into most classrooms across the country and it's unlikely you'll find rows of desk all pointing toward the front of the room. Educators have since realized their classrooms must mimic the workforce, which has

inspired them to create collaborative-friendly spaces to facilitate student learning. The onboarding of technology has supported their endeavor. 21st century classrooms are SMART boards instead of chalkboards and pods of SMART desks instead of individual seating. Students are going on virtual field trips instead of merely reading from a text; they are creating media instead of just looking at it. The redesigned learning space is laden with integrated technology, which means students aren't just using these things, but they are understanding *how* to use them in order to achieve a specific goal. Moreover, some of these learning spaces aren't even in the classroom. Colleges and universities are creating more informal campus learning spaces because they understand the importance of creating and collaborating 24/7, not just when class is in session.

Artificial Intelligence. The use of AI in higher education has already proven useful. Australia's Deaken University used IBM Watson to create a virtual student advisory service that was available 24-hours a day, seven days a week. Watson's virtual advisors fielded more than 30,000 questions in the first trimester, freeing up the actual advisors to handle more advanced issues. Another use for AI includes chatbots. Because chatbots are equipped with Natural Language Progression, as found in Siri, they have the human capability of answer questions about homework, helping students through a paperwork process like financial aid or paying bills, and easing the workload of the people who would normally serve these roles. Other applications of AI in education include personalizing learning (which is discussed in more detail below), evaluating the quality of curriculum and content, and facilitating one-on-one tutoring with the use of Intelligent Tutoring Systems. Technology doesn't aim to replace teachers, only to complement them.

Personalized Learning. We are able to personalize learning more now than ever. From school choice – public, private, charter, virtual – to the options available for *how* a student learns, education can be tailor-made to suit each individual. Blended learning gives more responsibility to the student, as it involves less direct instruction from the teacher and more discovery-based methods of learning. Blended learning is an example of how students can control certain elements of their learning

by making decisions about things like where and at what pace they move through material. Adaptive learning is similar to blended in that it, too, allows students to make decisions about things like the timeframe and path of their learning. Adaptive learning technology collects information about student behavior as they're answering questions, and then subsequently uses that information to provide instant feedback in order to adjust the learning experience accordingly. Educational tools with adaptive SEQUENCE continually analyze student data in real-time and make split second decisions based on that data. It automatically changes what comes next in a sequence, be it altered content or a different order of skills, in response to how student a student is performing. Another learning platform, Osmosis, was created by doctors for doctors and has revolutionized the way medical students study: "Using evidence-based educational concepts such as questions, flashcards, and videos, images correlated with memory anchors, adaptive spaced repetition, collaborative learning and gamification, Osmosis maximizes learning and retention." Such personalization is turning education into a "choose-your-own-adventure" method of learning, capitalizing on student interest and engagement.

Gamification. Playing and learning collide when classrooms utilize gaming as an instructional tool. Gaming technology makes learning difficult subject matter more exciting and interactive. As the technology progresses, it is quickly being used to enhance educational games in every discipline. Drexel University's Senior Vice President of Online Learning, Susan Aldridge, credits these games with mirroring real life issues, requiring students to use a valuable skillset to solve them: "These virtual game worlds provide a unique opportunity to apply new knowledge and make mission-critical decisions, while identifying obstacles, considering multiple perspectives and rehearsing various responses". Because these games are designed to provide immediate feedback, students are intrinsically motivated to keep playing them, honing skills throughout.

New technology and new learning models are exciting and offer previously unthinkable possibilities to students, but they require constant IT support. As educational institutions continue to jump on the bandwagon and adopt these digital

transformation trends, we must consider the current paradigm for technology instruction and move toward a team-based approach. As student expectations increase, responsiveness to those needs must increase as well [9].

Therefore, teachers need to master digital technologies. In particular, the use of artificial technology is an interesting and promising direction intelligence in the educational process. "Artificial intelligence is a toolkit of a system service that can be used to collect and adapt user data (or data placed in open repositories) and generate new solutions based on them or conclusions, according to the user's request. The use of artificial intelligence can help students perform common tasks in the classroom process and determine the previous level of preparation".

"Recently, the company OpenAI introduced a chatbot based on artificial of ChatGPT intelligence, which impressed users with its advanced features. ChatGPT artificial intelligence based chat bot is a specially designed neural network as a personal assistant. This chatbot can interact with the interlocutor, answer questions, prompt and give advice".

Researchers note the advantages of using artificial intelligence systems (AIS) in education:

1. Artificial intelligence systems adapt to the learning needs of each student and goals according to their strengths and weaknesses.

2. Artificial intelligence systems analyze and observe the student's current learning style and existing one's capabilities and provide a customized content and support template.

3. Systems artificial intelligence is evaluated not only by closed answers in a test format, but also descriptive.

4. Thanks to artificial intelligence, students do not hesitate to make mistakes, which they do an integral part of learning, and then receive real-world feedback time to make the necessary corrections.

5. Adaptive learning is used students at the elementary level, and then gradually moves to the next stage, completing the previous one.

6. Artificial intelligence can give students access to education according to needs, for example by reading content to a visually impaired student.

7. Artificial intelligence can be dosed and used in preschool education for presentation of interactive games that teach and develop children's basic skills.

8. Can be used to create educational content: widely artificial intelligence programs are used, which transform the voice into text (Figure 2.12) [10].
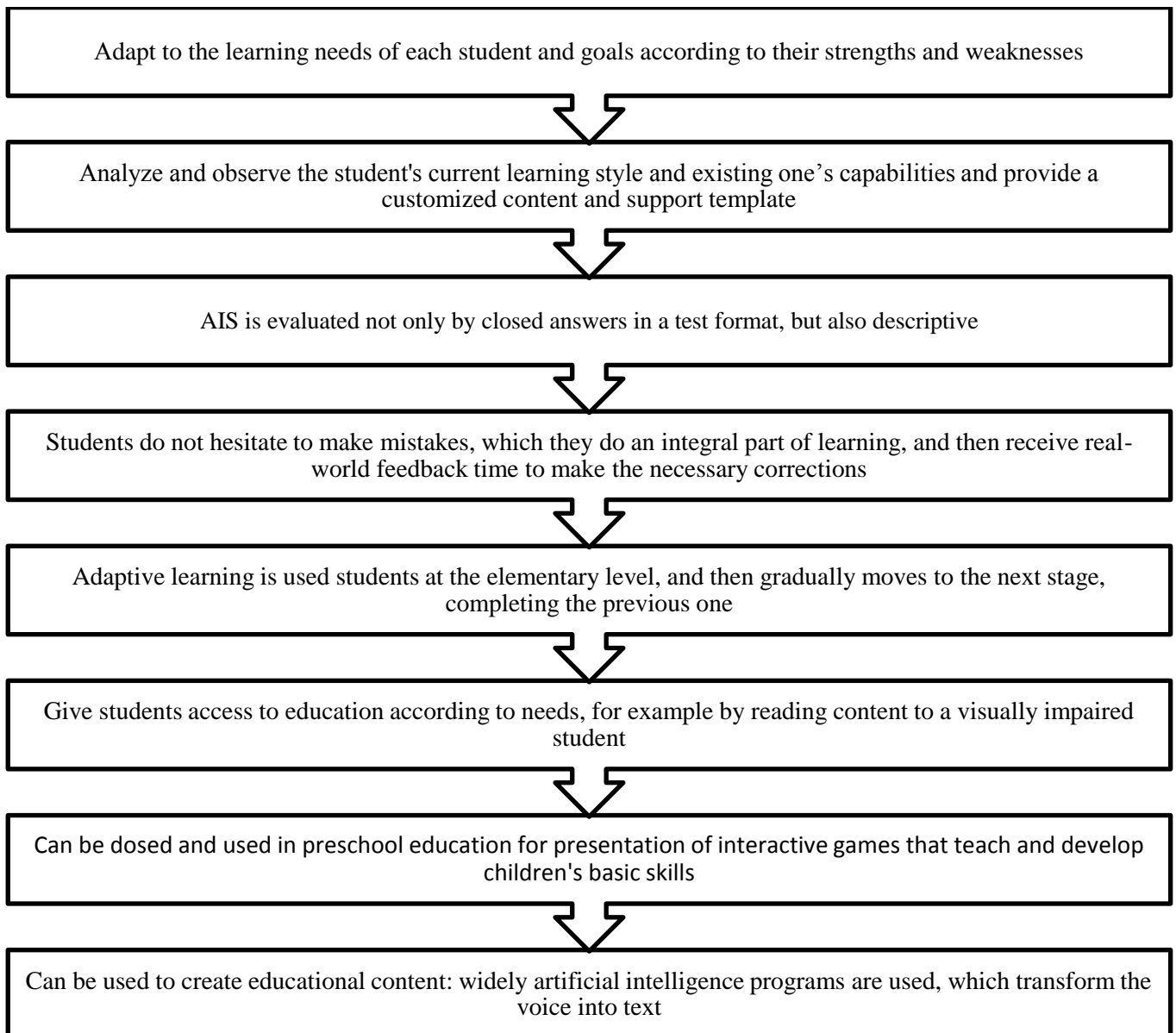
Adapt to the learning needs of each student and goals according to their strengths and weaknesses

Analyze and observe the student's current learning style and existing one's capabilities and provide a customized content and support template

AIS is evaluated not only by closed answers in a test format, but also descriptive

Students do not hesitate to make mistakes, which they do an integral part of learning, and then receive real-world feedback time to make the necessary corrections

Adaptive learning is used students at the elementary level, and then gradually moves to the next stage, completing the previous one

Give students access to education according to needs, for example by reading content to a visually impaired student

Can be dosed and used in preschool education for presentation of interactive games that teach and develop children's basic skills

Can be used to create educational content: widely artificial intelligence programs are used, which transform the voice into text

Figure 2.12. The advantages of using artificial intelligence systems in education

Source: compiled by [10]

However, the benefits are currently debated among researchers and practitioners and the harm of using artificial intelligence technology in education. One of the main and privacy is an important issue. Experts also note the disadvantages of using artificial intelligence: the cognitive abilities of both teachers and students may decrease. Too strong dependence on technology can also have negative consequences. It should be made artificial intelligence in addition to educational materials developed by the teacher. To teachers and students should not be forced to use artificial intelligence excessively.

When working with modern computer-oriented teaching aids, the possibilities of managing the process of solving didactic tasks increase, visualization of researched phenomena, processes and relationships between objects, modeling various educational situations with the help of video and audio reproduction, animation, graphics etc. Their use has a positive effect on all stages of the lesson: when studying, explaining new material, repetition, consolidation, diagnosis of students' knowledge, abilities and skills.

This contributes to increasing the motivation of students to study, revitalizing the cognitive interest, formation of key educational competencies (Fig. 2.13).
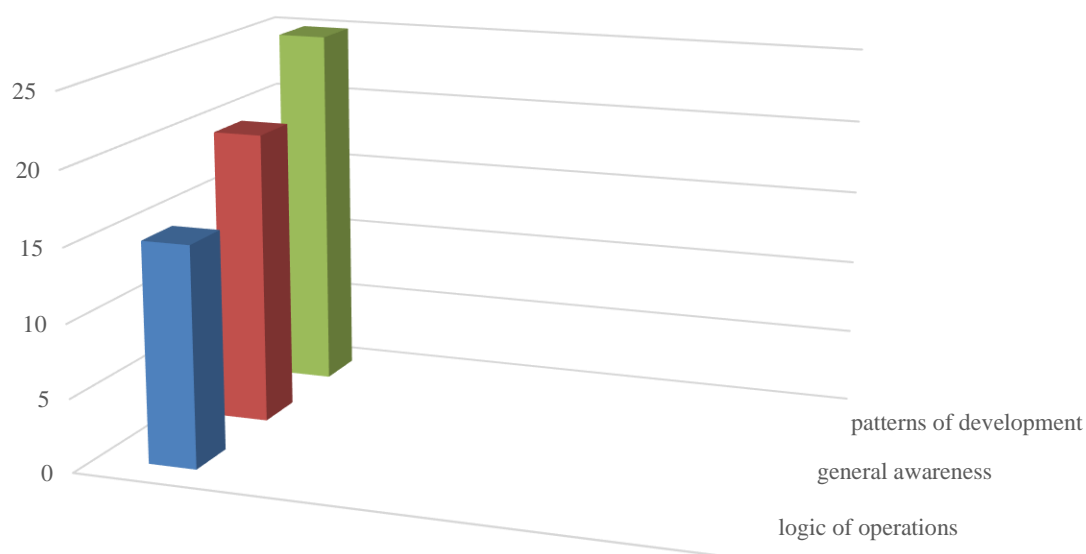

Figure 2.13. The impact of information technology on learning outcomes [11]

When using computer and digital technologies, the following results are achieved:

- the results of various logical operations are improved by 15-20%, the formation of such qualities as accuracy, precision, organization;

- awareness of the surrounding world increases by 20%;

- by 25% the awareness of subject regularities expands and deepens branches and interdisciplinary connections [11].

Computerization of general secondary education institutions of Ukraine is noted dynamic development. The share of general secondary education institutions equipped with computer equipment and connection to the Internet, demonstrates positive dynamics throughout the analyzed period. In 2020-2021, almost all (99.8%) general secondary education institutions are equipped with computers and by connecting to the Internet (Table 2.7).

Table 2.7. The state of computerization of general secondary education institutions in Ukraine, 2022 [12]

Indicators	The value of indicators
Number of general secondary education institutions, units (September 5, 2021)	13.991
Connected to the Internet general secondary education institutions, units (January 1, 2022)	13.979
- connected to the optical Internet, units	8.580
Connected to the state e-magazine, units	691
The regional and regional education departments are connected of local levels to the collection of e-reporting, %	100
Involved computer equipment, unit	62.674

An analysis of the characteristics of computer technologies and computer science shows that they are relentless intensive development, emergence of new means and renewal of existing ones. During the last years, the range of tools used in the educational process of general secondary education institutions has expanded significantly: multimedia boards, laptops, netbooks, tablets, e-books. Most of new devices have characteristics significantly different from the generally known characteristics PCs, in particular, are equipped with touch technology. Radical

changes also took place in school's boards: from wooden to multimedia and interactive panels.

Digitization permeates all components of education. In this context, educational transformation is carried out in accordance with strategic priorities that ensure quality improvement environment of teaching, learning and educational management. In Ukraine. 66% of Internet users use it to log out to the Internet smartphone, 40% – home laptop, 36% – stationary home computer, 14% – a tablet, 5% – a desktop computer at work, 4% – a work laptop (Figure 2.14).
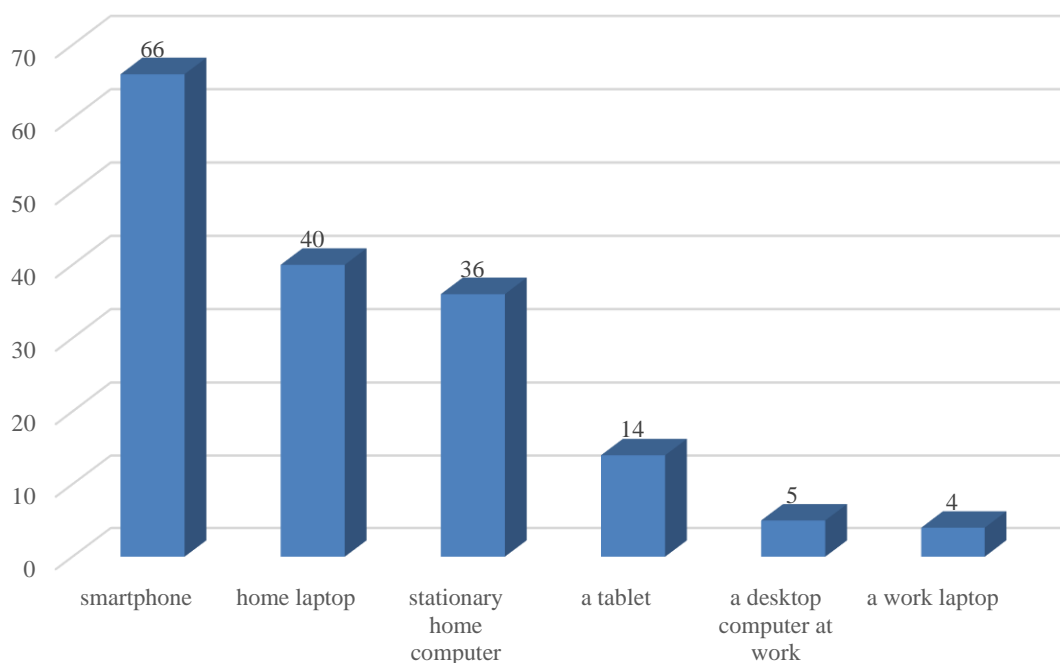

Figure 2.14. Internet access tools for education [12]

The new stage of the scientific and technical revolution, the widespread introduction of automation, computer technology and new communication systems against the background of the spread of market relations in our country has a multifaceted effect on the sphere of work, on the role and employment of man in social production [13].

Digitization of education is a modern stage of its informatization, which involves saturation information and educational environment with electronic and digital devices, means, systems and establishment of electronic communication

exchange between them, which in fact enables the integral interaction of virtual and physical, i.e. creates cyber-physical educational space.

One of the characteristic features of the innovation strategy should be ensuring close integration of production, science and education [14]. In the conditions of rapid digitalization of the economy, more and more attention is paid to the study of this issue in education as well. Most universities are actively implementing elements of distance and online education, moving to electronic document management and digitalization of educational processes [15].

The digital transformation of the general needs further research of secondary education, studying the progress and challenges achieved in solving a number of issues related to the digitalization of school education, the impact of the digital transformation of education on the personalization of learning and the expansion of educational opportunities.

Based on the analysis and generalization of the above-mentioned documents, the key areas of digitization of general secondary education common to the EU countries were identified and characterized:

1) *reliable infrastructure*, the key elements of which are high-speed connection to internet and devices available to teachers and students as needed; high-quality educational content, user-friendly tools and secure platforms that adhere to digital privacy and ethical standards; as well as professional development for teachers and manager's educational institutions;

2) *digital literacy*, including combating disinformation, basic digital skills and competences from an early age;

3) *digital competence and skills for teachers* that enable effectively and creatively use digital technologies to engage and motivate their students, support them in acquiring digital skills, ensure equal access to digital tools and platforms for all students, improving teaching, learning and assessment;

4) *assessment and assessment approaches using digital technologies* that provide new opportunities for self-reflection, feedback, and evaluation of the teaching staff and educational institution;

5) *artificial intelligence technologies in education for personalization and training efficiency*, which helps participants in the educational process to best adapt to educational needs, save time and focus on more important educational goals.

It is important for Ukraine to coordinate the directions of development of the digital transformation of education with the requirements of the world and European educational and research spaces. This means the consistent implementation of the documents defining the framework agreed upon in European countries requirements for the development of a highly effective digital ecosystem of education and the improvement of digital skills and competencies in the conditions of the digital transformation of education.

Generalization of the best experience, analysis of ways and tools of digital transformation of secondary education and organization of evaluation of all participants of the educational process on the implementation of digital technologies allows to reach conclusions:

1. The modern education system, the educational process of every educational institution, needs a digital transformation that can ensure the quality of the educational process. To ensure the effectiveness of this process, it is advisable to design an educational policy, including digitalization, at all levels of education.

2. Thanks to the rapid development of digital technologies and modern techno trends, a systematic approach to the transformation of the education system involves the complex interaction of all participants in the educational process on the way to a comprehensive systemic analysis of the digitalization of the educational process and the creation of a digital educational policy based on it.

3. Digital technologies are important educational technologies that help teachers to increase the efficiency of the educational process. Information and digital the competence of the modern teacher needs further improvement. For this, it is necessary to develop and introduce new educational programs in accordance with the pace of digital development technologies, in particular artificial intelligence technologies. Future prospects of research there is a need to investigate the issue of

possibilities the use of artificial intelligence technology in the educational process to improve its effectiveness.

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