

Strengthening Students' Proficiency in Digital Technologies and the SMART Society

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Abstract: *The relevance of the article is that nowadays digital technologies are an effective means of differentiation and personalization of educational activities, they change the face of today's education, turning it into the top rank of human capital investment in the digital age. The shift to digital education requires the collaborative effort of instructors, administrators, and learners to create and meet educational goals, using data analysis to provide individualised learning plans for students. The article is devoted to the issue of formation of digital skills in the learning process of students. The concept of digital literacy and digital skills, as well as the classification of digital skills is considered. The author proposes indicators and criteria for assessing digital skills, as well as theoretical and practical training of students, presented in the form of several modules. The choice of research methods is conditioned by the peculiarities of studying informatization and digitalization, as well as the peculiarities of using up-to-date information technologies in the educational process. The following methods were chosen: analysis of psychological, pedagogical and methodological literature, descriptive method, method of generalization, system-structural analysis, method of interpretation and semantic reconstruction of pedagogical sources.*

Keywords: *Digitalization, digital literacy, digital skills, digital skills classification, SMART education.*

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Introduction

Digital competence is a set of several digital skills and acquired knowledge for continuous application in professional activities.

Possessing digital competence equips an individual with the necessary abilities, understanding and aptitude to use digital technologies to realise personal goals. In the education system, digitalization dictates to students the two tasks of developing their own digital competences as well as developing the competences they need to function in the digital world. It is important to be able to study digital traces of actors' activities in new conditions, to extract new knowledge from digital actions.

According to a number of digital skills researchers, such skills should be understood as competencies in the use of PCs and the Internet, as well as the student's willingness to acquire relevant knowledge and practice (Smater & Zieliński, 2015, p. 264).

Digital skills are the ability to use available skills and knowledge in analyzing, selecting and making sense of data. Thus, it is the ability to use information technology to interact in order to use it effectively and ensure great productivity and efficiency.

Digital skills should be considered along a continuum of using communication applications, digital devices to search and manage data.

They also enable the generation and distribution of digital content, collaboration and communication, and problem solving.

The purpose of the article is the theoretical justification of the main approaches to the formation of digital skills, identification of ways to form digital competence of students; proving that digital technologies are an effective means of differentiation and personalization of educational activities; research of cognitive and metacognitive aspects of SMART-education of students.

Used methods, techniques and technologies

The choice of research methods is conditioned by the peculiarities of studying informatization and digitalization, as well as the peculiarities of using up-to-date information technologies in the educational process. The following methods were chosen: analysis of psychological, pedagogical and methodological literature, descriptive method, method of generalization, system-structural analysis, method of interpretation and semantic reconstruction of pedagogical sources.

The main sources for the preparation of this article were the latest publications of domestic and foreign scientists on the issues of informatization, digitalization, and the use of digital technologies.

Formation of digital competence of students

As noted by Dicheva et al. (2015), digital competence of students is represented by skills and abilities that ensure effective and safe use of digital technologies and Internet resources (p. 79). According to them, digital literacy is based on digital competencies, such as the ability to solve a wide range of tasks in the field of ICT application. It is also the ability to ensure digital collaboration, security, and problem solving.

Students' digital competence includes the skills and ability to interact:

- with data representing digital content. In particular, it is necessary to be able to search for data on the Internet, analyze and make sense of the findings, transform digital content, and store data using, among other things, cloud technologies;
- with PCs. In particular, it is necessary to know how a computer and its software are organized;
- with media information. Different kinds of data, such as text, pictures, audio and video recordings, are encompassed here. It is important to be able to analyze their quality, reliability, truthfulness, and usability, taking into account the impact of media content on people;
- with online venues. In particular, it is possible to obtain various services on state and municipal websites (register and work in a personal account), use Internet banking (technologies that provide remote banking services), select and order products and services on online platforms, create travel itineraries, buy airplane and train tickets, use social networks and messengers for communication.

One also needs to be able to protect one's personal data, take public open online courses (MOC) and use online educational platforms for lifelong learning.

Typically, students' digital competence includes digital skills, i.e. sustainable behaviors (technical, intellectual and personal) based on digital knowledge. This may involve using electronic devices or communication applications to access and manage information.

Digital literacy empowers teachers to explore new techniques of instruction through podcasts and videos that will captivate students.

The concept of digital literacy includes an expanded range of knowledge and skills, competencies and abilities applied in everyday life and

in learning and working in the conditions of the digital community. This includes:

- digital identity and well-being or self-actualization;
- digital education, professional and personal growth;
- digital communication, participation and engagement;
- digital creativity, science and innovation in the digital space;
- media literacy and information competence.

Given the speed with which technology and the opportunities to work in the digital space are changing, digital competencies indicate a growing range of ever-changing skills.

Digital competencies are a set that includes analytical thinking skills, character traits, work habits, knowledge, experience, and types of behavior. That is, they are represented by both technical and cognitive skills and non-cognitive social skills (interpersonal interaction and communication).

Accordingly, today's students have already formed basic digital skills and it is necessary to form intermediate and advanced skills.

Teachers, especially those with extensive experience, should be singled out separately. These teachers are the carriers of academic knowledge and students are the carriers of digital skills. The most productive and exact procedure to unify all of this is to establish interaction between them (Fenwick & Edwards, 2016, p. 119).

The level of digital skills available, as well as current and future digital skills needs, should be established. To assess digital skills within a self-assessment framework, respondents should identify their own measures of knowledge, skills, confidence or use. It is common to use questions with a rating scale whose values are pre-determined (e.g. a scale of 1 to 5), questions with multiple choice answers, and questions with only affirmative or negative answers. In skills assessment, self-assessment takes the form of a questionnaire. Since self-assessment can be done fairly quickly, it is sometimes combined with other types of assessment. The scope of the assessment and the range of skills assessed may vary. Self-assessment can cover an almost limitless range of skills, including both basic and advanced skills.

The formation of digital skills should be done in stages. Students are provided with theoretical and practical instruction through various modules (Bruce & Chiu, 2015, pp. 272–274):

Module 1: Legal and methodological foundation for shaping students' digital culture.

1. Recent developments in the evolution of education.

2. Educational standard as an underpinning for the design of the basic educational program of an educational organization, exemplary basic educational program, educational program of an educational organization.

Module 2: Theoretical foundations of digital, media and distance education technologies.

1. Individual, psychological and age characteristics of students.
2. Peculiarities of the organization of learning activities in the conditions of implementation of digital and media technologies.
3. Digital culture. Digital literacy. Digital competence. Digital preservation. Digital skills.
4. New social demands of educators – set of basic knowledge and skills (digital, legal, financial) – digital competencies.
5. The components of a student's digital literacy.
6. Digital literacy of the student: main concepts and definitions. The region's experience in the realization of e-learning, training with the use of distance education technologies. educational technologies. Problems and prospects of development.

Module 3. Media technologies in training with the use of distance education technologies

Media technologies in learning. Effective communication on the Internet. Use of social networks and messengers. Network ethics of participants of the digital educational process. Basic rules and techniques. Overview of popular platforms for organizing distance learning. Integration of a graphic tablet in online learning. Using a graphic tablet in an online lesson. Overview of online whiteboards with real-time collaboration. Online whiteboard for real-time collaboration: interface, toolbar, settings, peculiarities of use in online lessons.

Module 4. Didactic, psychological, hygienic requirements for online lesson (4 hours).

Didactic basics of the educational process. Technique of conducting a distance lesson. Algorithm of actions of a teacher in preparation for a distance lesson. Setting lesson objectives. The main stages of a distance lesson. Integration of digital educational resources in the lesson. Planning the results of a distance lesson. Running an online video teaching session (Microsoft Teams, Zoom). Blended learning practices.

Module 5. Developing digital educational resources

Use of digital educational resources at lessons (review of resources by subject branches). Review of services for developing interactive tasks and Web 2 tests – LearningApps.org, Web-quests. Services for developing online

tests: Master-test, Test Builder.ru. Registration in the services, interface, customization, features of test creation.

The variety of scenarios for passing web-quests will allow students not only to improve their skills in the application of information and communication technologies, “pump up” their digital skills. The use of web-quests in practice during extracurricular activities in educational organizations shows that students learn competent behavior in the network, practice and analyze simulated situations.

Module 6. Cloud services. Cloud storage: Google Disk. Basic principles of operation, accounts, web access, local agent. File sharing tools. Data storages. Work with Google tools: disks, presentations. Forms of work with Yandex tools: disks, documents, interactive presentations. Digital platforms (Prezi, Canva).

Work with documents, tables. Basic principles of using cloud services for working with documents. Creating, editing documents through cloud services. Saving a document on a local storage medium. Collaboration. Restricting access, granting access, customizing access levels. Google Forms. Basic principles of work.

Digital technologies are an effective means of differentiation and personalization of educational activities

Digital education content represents an ever-evolving framework of values, competencies, knowledge, skills, and capabilities. It encompasses a variety of activity forms and types, drawing from social experiences. Mastery of this content, achieved through diverse educational approaches, fosters the well-rounded and personalized growth of an individual within a specific socio-cultural context. This development aligns with the individual’s abilities, interests, and societal expectations, encompassing those of the individual, family, society, and the state.

In this setting, the development of the essence of digital education, which guarantees the comparability of knowledge, values, skills and competencies attained and identified in different kinds of personal activities, is of particular relevance. The world education is currently dealing with the intricate and complex mission of developing the core of digital education (Kaplan & Haenlein, 2016, p. 447).

It must be stressed that this is not purely a scientific and educational problem. In the digital economy, it has become a matter of strategy, as education has to cope with the challenges of a rapidly changing society and economy.

Simultaneously, it is a socio-political issue, since education should foster social cohesion in the face of ever-increasing diversity and foster the emergence of new forms of collective consciousness. It is also a socio-economic problem (education should respond to the challenges of specific labor markets, including at the regional and municipal levels), a general civil and cultural problem.

In this regard, business, government, society, and family are the “customers” for the development of the core of digital education. The state solves strategic issues of its own development, consolidation of the nation, national security, and competitiveness through the sphere of education.

It is important for society that education ensures social sustainability and development. Families trust that education will help children to successfully gain personal and professional objectives and expectations, create circumstances for social achievement, mobility and health maintenance (Uribe & Vaughan, 2017, pp. 298–299).

Business needs high scientific and technological potential to improve competitiveness and highly qualified personnel capable of continuous professional development, flexible and adaptive to change, with competencies of the digital economy.

The core of digital education is a digital system open to the outside world. It is a value, activity and content base for the formation of a digital socio-cultural educational environment (ecosystem) of the country. The foundation of digital learning is the essential for advancing principles in subject branches, educational programs of all levels of continuing education and areas of expert training, regulatory and supervisory strategies, educational technologies, educational and methodological support, methodological and logistical aid of the educational process. Creating the above definitions and forming the core of digital education can be considered as one of the methods of creating a digital environment and identifying ways to transform it.

In the course of the conducted research, a model of students' digital environment was built, which allows to realize in practice the tasks facing the education system. What is a digital environment? It is a building that has access to the Internet, personal computers, interactive whiteboards. Students' digital environment is an open sociocultural educational environment (ecosystem), personalized learning process based on the analysis of requests and needs of students' educational behavior in their interaction between themselves and other participants of the ecosystem.

The digital environment serves to make sure individuals can socialize efficiently in the high-tech social environment of society, comprehend and

replicate its values, standards and regulations of behaviour, knowledge, aptitudes and competences in the conditions of convergent reality, shaping the identity of the individual, and its ongoing comprehensive development (Poulova et al., 2015, p. 1305).

The model we have proposed is clear in its emphasis that the digital environment not only offers training and education, but also a successful incorporation of the individual into a technologically advanced and quickly evolving complex landscape.

The purpose is realized through a system of tasks that need to be solved to achieve it. They are as follows: a) using automated systems to observe and manage the outcomes of educational activities to evaluate their effectiveness; b) offering access to validated educational material with integrative variants; c) implementing automation in accounting and overseeing additional educational services to raise their economic efficacy; d) informing parents to involve them in education and making data accessible; e) moderating student activities in the digital space to facilitate the timely recognition of risk components in the growth of a child's character for the promotion of student success, safety, and the establishment of a comfortable social climate; f) incorporating automation into the main processes of staff and student activities to reduce mundane operations and boost time for personalizing learning; g) securing the incorporation of general and additional educational projects particularly in a distributed network mode to form a personal educational trajectory for every pupil (Berbets et al., 2021, p. 316).

Achieving the aims and objectives of the digital school relies on the effective deployment of specialized educational technologies. In the context of the digital school, educational technologies represent collaborative frameworks involving various participants in educational endeavors. These frameworks encompass the planning and realization of educational objectives, the methods to attain them, and their assessment, all of which are grounded in extensive data analysis. These technologies are instrumental in meeting the personalized educational requirements of students.

Current educational technologies include: personalized learning, adaptive learning, online learning, blended learning, flipped learning, LOD (learning on demand), synchronous/asynchronous learning, gamification, technologies for organizing project research activities, cloud-based learning, social educational networks, acquiring knowledge through virtual and augmented reality (simulators, simulators, biometric sensors, etc.).

Establishing a digital learning environment that is dynamic and accessible can be achieved through the implementation of a digital education

model. This helps implement new techniques and technologies for the learning process, automates academic and administrative tasks, increases parental involvement in students' educational development, improves student safety (including cybersecurity) and meets the individual learning needs of every student (Onishchuk et al., 2020, pp. 46–48).

When discussing the layout of the digital landscape, we must address the roles of both the student and the teacher. In the context of the digital landscape, the ideal student is one who, considering both the immediate and long-term outlook, embraces the values and individuality of others while respecting their rights and freedoms. This student adeptly manages their own self-identity and reputation, possesses the capacity for self-actualization and self-realization and holds deep affection for their nation, region and homeland. They exhibit reverence for and adherence to the rights associated with personal, state, corporate, and intellectual property. This student also comprehends and embraces traditional human values encompassing life, family, and civil society, as well as humanity as a whole. They are characterized as creative and critical thinkers, actively and purposefully engaged in continuous learning and motivated to expand their knowledge. Furthermore, this student exhibits the ability to self-regulate, self-organize and engage in reflective thinking, while also demonstrating a propensity for innovative endeavors. They are socially active, principled, responsible, benevolent and ready for productive collaboration and effective interaction with individuals, even those with dissimilar backgrounds, including remote interactions. This student embodies a harmonious development, consciously adheres to the principles of a healthy and environmentally responsible lifestyle that ensures the well-being of both individuals and the environment. They possess a professional orientation and resilience in the face of change (Honchar et al., 2020, p. 366).

The teacher of the digital environment ensures the formation of values of the network educational community, skills of self-identification, own and students in a convergent environment, creates motivation for continuous search and learning, performs the function of a navigator, mentor and tutor in information flows, moderates social educational networks, organizes students, in particular in social educational networks, qualitatively implements various models of e-learning, distance and mobile environment, creates motivation for continuous search and learning, serves as a navigator, mentor and tutor in e-learning, distance and mobile education, understands the importance and value of continuous professional development.

It is important to emphasize that the digital environment does not exist on its own.

By creating a digital educational environment, it integrates into other digital educational environments, thus forming the educational ecosystem of the municipality and the whole country.

Cognitive and metacognitive aspects of SMART student learning

The current educational theory has two divergent understandings of the smart-education concept. Certain researchers regard smart-education as a significant step in the progress of the educational system, which will cause substantial transformations in the approaches to teaching in schools and universities.

In this context, we can guess the paradigm of large-scale formational changes in methodology, the main message of which is to evaluate the previous formats of education as outdated and not relevant to modernity, and emphasize the advantages of a new model of education as more progressive and, therefore, historically prioritized. We can conditionally call this understanding of smart-education “modernist”, which is characterized by a hierarchical worldview and the search for a monostrategy for the development of the education system. Other researchers offer a more flexible interpretation of the new educational paradigm, considering it not as the highest point in the development of modern education, but as one of many other learning formats, which has both advantages and disadvantages, and can become a supplement (but not a substitute) to existing educational methods and technologies. Smart-education comprehended in the “postmodern” way necessitates “forced pluralism” of formats and teaching methods, deconstructing educational paradigms claiming the highest hierarchical positions, and disassembling of established learning structures (Bykov & Ovcharuk, 2017, p. 58).

The definitions of the concept of smart education used in the current specialized literature quite often “sin” logical vagueness or too much semantic volume, which does not allow to grasp the essence of this phenomenon. Occasionally, smart-education is understood as an organized and carried out with the use of technical innovations and the Internet interaction between the subject of science, student, teacher and other participants of the process, aimed at the formation of a systemic multidimensional vision of the subject of science, including its different aspects (economic, legal, social, technological, etc.).

At the same time, it is rather difficult to clarify the fundamental differences between smart-education and e-learning or mlearning paradigms

or other formats of interaction between learners and those who teach using technical innovations. The very construction of the term smart-education deserves additional phenomenological analysis.

In English there are three words meaning “smart” – smart, clever and intelligent, and it is the last variant that seems to be more successful, as it includes connotations of intelligence, intellectuality, deep education. The advantage of the concept “smart” is probably due to its additional meanings of stylishness, fashionability, which in today’s consumer society acquire a special meaning and relevance.

As stated by Watson et al., (2015), smart-education, enabled by cutting-edge technology, enables users to quickly gain knowledge in a convenient online learning format (p. 335).

A descriptive definition of smart-education, which presents its main advantages and varieties, can be recognized as more meaningful. First of all, we are talking about several learning formats that are most in demand today: first, these are modular digital learning environments organized on various Internet platforms (e.g., PIES, NGDLE), which allow to manage students’ online learning, control its quality and systematicity.

Experts see the advantage of such a format of education in the ease of access to relevant Internet platforms at any time and anywhere in the world, in the possibility of relatively continuous interaction with teachers and students, in the availability of various learning materials (lecture notes, presentations, tasks), which are presented online. Secondly, one of the most popular formats of smart-education is MOOCs (Massive Open Online Courses), which allow users to take certain courses in order to deepen their knowledge, obtain new information or continue their studies after graduation (thus, MOOCs can be considered as a form of virtual localization of lifelong learning). MOOCs offer users the chance to experience the finest educational material from the top universities, covering formal, non-formal and informal educational contexts; flexible schedule of the most prestigious universities; flexible schedule of individualized learning. Thirdly, smart education can be presented in the formal educational context as a supplement to traditional learning formats (we are considering the implementation of electronic gadgets and interactive Smart Boards in classroom activities), which provides additional opportunities to search for relevant information on the Internet, to create an intellectual product online (“here and now”).

Tømte et al. (2015) pinpointed a crucial overarching trait of smart learning: its alignment with the cognitive and psychological traits of today’s student and schoolchild generations, commonly referred to as Generation Y and Z (born in 2002 and after 2003, respectively). These generations are

marked by their heavy reliance on Internet technologies and virtual communication realms. Their distinctive characteristics include a reduced capacity for sustained focus on a single information stream, a strong inclination towards processing multiple information streams simultaneously, and a preference for interactive and playful formats when acquiring information (Tømte et al., 2015, p. 27).

Some other cognitive aspects of smart-learning can also be highlighted, such as pedaling of students' transactive memory (tendency to check information to online devices, as a result of which the process of memorization is weakened and personal hope for computer "hints" in the learning process is strengthened).

Smart-learning, with its emphasis on the transmission of information rather than the acquisition of knowledge, tends to foster a critical attitude.

As highlighted by Lai & Hong (2015), a fundamental interpretation of "smart" revolves around the capacity of a given system to promptly adapt to shifts in its surroundings and effectively manage challenging or precarious circumstances (p. 734).

Kaivo-oja & Roth (2015) refer to the process of producing quick-thinking (comparable to fast-food) or reasoning "with ready-made concepts" – fast thinking that is effortlessly and rapidly achieved by pressing a few computer keys (p. 23). However, deep knowledge (rather than superficial information) can only come from slow (rather than fast) thinking about a particular problem, in live interaction with experienced teachers/scientists who are fluent in a particular topic.

In today's theory smart-education is studied in the context of forming not only cognitive, but also metacognitive abilities of students, which are understood as the process of "thinking about their thinking", the ability to monitor qualitative and quantitative characteristics of their mental abilities (speed, content, efficiency, style, error-free), range, independence of thinking). As the results of psychological experiments show, developed metacognitive abilities correlate with higher educational achievements and better academic performance of students. It is difficult to say that there is an unambiguous connection between smart-education and the problem of formation of metacognitive abilities of students. On the one hand, current researchers speak about the necessity and even inevitability of developing metacognitive skills in online learners. Since smart-learning is conducted with relatively little control from the learners, it is essential for students to be able to monitor their learning progress, locate relevant material, organize their activities, finish tasks on time, and assess the quality of their work, all on their own.

Alternatively, there is data that suggests indirectly that online students are lacking in metacognitive capabilities, such as the ability to manage and keep track of their learning process performance. We are exploring a problematic situation in which only a small fraction (2-19%) of those who finish virtual courses have the mental capacities of self-discipline and monitoring of their studying activities (Virgillito, 2017, p. 241).

An important role in the learning process (including smart-learning) is played by the combination of developed metacognitive abilities with the established learning motivation and reach of the individual, forming a single pattern of cognitive skills.

With this pattern in place, the student will be able to achieve high learning outcomes in the context of both traditional and smart education, which can be combined in a blended learning format.

Conclusion

The article considers some of the current discussion issues related to digital education. It delineates the conditions for the beginning of a new era – the era of digital education, explains the definition of the word “digital education”, justifies the importance of constructing the core of digital education, portrays the model of digital educational setting, reveals the structure of the educational ecosystem and ascertains the consequences of its application for different stakeholders. To summarize, we emphasize that world change and change are interrelated and mutually conditioned.

The article theorizes the main approaches to the formation of digital skills in students and proves that digital skills are the ability to use skills and knowledge in analyzing, selecting and making sense of data. It is concluded that it is the ability to utilize information technology to interact in order to use it effectively and provide great productivity and efficiency. Digital skills are considered as a continuum of using communication applications, digital devices to find and manage data, as these skills enable the generation and dissemination of digital content, collaboration and interaction, and problem solving.

The article also identifies the ways of forming digital competence of students and proves that the formation of digital skills should be carried out in stages. Theoretical and practical training of students is presented in the article by several modules. It is proved that digital technologies are an effective means of differentiation and personalization of educational activity.

The article investigates cognitive and metacognitive aspects of SMART-education of students and proves that in the current theory smart-

education is studied in the context of forming not only cognitive but also metacognitive abilities of students, which are understood as the process of “thinking about one’s thinking”, the ability to track the quantitative characteristics of one’s mental abilities (speed, content, efficiency, style, error-free, range, independence of thinking), and advanced metacognitive abilities correlate with higher academic achievement and better student performance.

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