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CONTENT

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Cognitive and Play Space of Educational Institutions of the Future: Trends, Models, Cases

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Abstract: The play is a spontaneous, creative, and purposeful activity oriented towards child's learning and personality development. To make the play effective, the educational institution organizes adequate cognitive and play space. The aim of the article is to analyze the main trends, models and cases of cognition and play space organization as well as the outlining of the most efficient methods that can be applied within the educational institutions of the future. In the article one used a number of theoretical methods including the analysis of scientific and pedagogical literature, the synthesis of research results and the main trends of play space organization in modern educational institutions. The following empirical methods of research were also applied: focus group interviewing, pedagogical observation, and closed questionnaire survey. To process the data obtained during the pedagogical experiment the methods of statistical analysis were used. The research results showed three main models of cognitive and play space organization at the modern educational institutions: nature-based or outdoor, indoor, and virtual ones. Each of them has its own advantages and disadvantages. The choice depends on the learning objectives, institutional resources, teacher's pedagogical readiness, technical possibilities of educational process, and external condition. The survey proves that it is necessary to

combine the elements of different models to make the learning positive. In such conditions hybrid or mixed cognitive and play space is applied. Such space is focused on learning activity stimulation and child's personality development in different conditions: outdoors, indoors, and virtually. The research demonstrates that well-designed hybrid cognitive and play space is essential for comprehensive and harmonious development of child's personality within the educational process. The research showed that hybrid cognitive play space is an appropriate model for the education institutions of the future as it is characterized by dynamism and multifunctionality.

Keywords: cognitive and play space, nature-based model, indoor model, virtual mode, hybrid model.

Introduction

The orientation of national educational system towards common values and democratic principles makes for individualization and socialization of child's personality has become a leading concept for pedagogues of new formation. From this perspective, in the context of paradigm-based search for improvement and modernization of today's educational process, existing education appeals to philosophical ideas of person-centered approach according to which a child and his/her needs are the biggest priority for the educational policy in general and institution in particular.

At present, a child is not seen as a passive object being influenced by a teacher or surrounding environment, but as an active creative subject contributing to the learning process. Therefore, this fact requires the construction of a developing space for child's self-actualization and self-affirmation. It is necessary to create all the conditions to meet children's needs, to provide their full and harmonious development while they study at the educational institution as this period is the most important for formation of cognitive sphere. And, obviously, play activity is a main method to study the environment, form social behaviour and cultivate communication skills. Also, plays intensify the process of upbringing and education considerably.

Naturally, it is necessary to provide the favourable conditions within the educational institution for implementation of play-based approach and to encourage every child to sharpen life skills including independent activity, decision-making, and interaction with other people. In order to achieve this, it is necessary to create an adequate cognitive and play space that considers the peculiarities of educational process and children's psychological characteristics as well.

Research Problem

According to Clark et al. (2020) and Shoari et al. (2021) the physical environment experienced by children and teenagers has a significant impact on their health and wellbeing. Typically, young learners spend up to 45 hours per week in schools (Shoari et al., 2021). As a result of this, educational institutions should initiate the building of special physical space to provide pupils with assets to play, to develop, and to promote health.

Thus, the problem of creation of cognitive and play space at the educational institution is particularly urgent and summarizing the advanced pedagogical experience in this sphere is necessary to implement the most efficient trends and models.

Research Focus

The educational environment of any institution is a complex phenomenon existing on various levels like global, national, regional, local/municipal, and institutional (Frelin et al., 2021). It is a zone of interaction of educational systems, their elements, educational materials, and participants of the educational process. Play space is an essential part of educational environment as it is an integrated system where material resources for child's development are used.

Simultaneously, Alharbi and Alzahrani (2020) consider play to have universal benefits for children's learning and development. Well-designed play can provide rich, fun, interactive experiences that can foster young children's learning and cognitive development, build their necessary skills, contributes to social interactions, physical activity, and healthy behaviors.

Playing does not mean children waste their time. At the young age, all the children predominately learn through play (Danniels & Pyle, 2018). This requires to organize an appropriate space that is able to use a play within the educational process. There are many approaches to build effective cognitive and play space applicable for the educational institution of the future.

One of the most successful models deals with the combination of social and natural elements (Alme & Reime, 2021). It is known as nature-based or outdoor cognitive and play space and it includes architectural and landscape installations, art studios, outdoor play and sports grounds, sports equipment, construction kits, toys, collection of books or audio and visual information storage devices (Kuo et al., 2019). The main feature of nature-based model is that the whole day or a part of the day is organized outside. Such nature-based model has different names like "nature school", "forest kindergarten" or "udeskole" (Boileau & Dabaja, 2020).

Outdoor cognitive and play space provides a learner with a number of benefits (Alme & Reime, 2021; Frelin et al., 2021; Kuo et al., 2019). It is claimed that a child learns better when he/she is attentive, less stressed, more interested, more physically active, highly motivated, and less stresses. Nature-based cognitive and play space establishes these appropriate conditions for young learners and they are likely to demonstrate better outcomes (Boileau & Dabaja, 2020; Kuo et al., 2019). In addition, they improve physical and psychological health (Alme & Reime, 2021) and acquire strong soft skills (Kuo et al., 2019; Storli & Sandseter, 2019).

There children receive skills needed in the XXIst century such as environmentally friendly attitudes and learn more pro-environmental behaviour (Kuo et al., 2019). Moreover, outdoor cognitive and play space encourages to use unsupervised activities, free play and, as a result, stimulate creativity and imagination (Alme & Reime, 2021; Hyndman & Mahony, 2018). According to Alme and Reime (2021) the use of the natural environment for educational purposes has become increasingly popular in the Nordic countries, the United Kingdom, Australia and the United States. Another model concerns indoor cognitive and play space and ensures organization of cognitive activity within interior institution facility (López-Chao et al., 2020).

Classroom or indoor cognitive and play space means the area where teachers can easily actively create the conditions for learning and development of children (Khudayberganova, 2022). According to Khudayberganova (2022) the inside learning is a place where all the equipment and devices, teaching aids, posters are available. Also, this space can be decorated and equipped with the prescribed rules

including daylight or artificial light, temperature, acoustic comfort, size, ventilation, and considering requirements to furniture orientation, electromagnetic waves, and vibrations (Kapoor et al., 2021).

The classroom environment allows children to interact face-to-face with their peers and teachers. This is an additional social benefit and educational assistance. Because learners see the same peers in each session, they will have the opportunity to build strong friendship (Khudayberganova, 2022).

Norwegian scholars Sandseter et al. (2022) paid their attention to comparison outdoor and indoor cognitive and play space and came to the conclusion that effective indoor facility requires sophisticated planning, furnishing, and application of deep knowledge of children's innate playfulness to predict and evaluate their play behaviour. But such model has lots of benefits as provides access to play materials and serves as a secure environment for young learners.

Besides, applying the indoor model teachers do not waste time for explanation the rules as the space itself is predicted and well known for children (Khudayberganova, 2022). Classroom activities provide a sense of discipline because children have no choice but to focus on learning (Berkling & Franken, 2019).

Indoor cognitive and play space is commonly used in many European countries like Spain (López-Chao et al., 2020), Denmark (Brink et al., 2020), Finland, Ireland, Poland, in some educational institutions of the USA namely Let's Move Active Schools (McMullen et al., 2022), and in Asia including Uzbekistan (Khudayberganova, 2022), India (Kapoor et al., 2021), South Korea (Lee & Kwon, 2021), Indonesia (Yuniastuti & Hasibuan, 2019), and Japan (Qin et al., 2019).

In modern conditions teachers and learners must adapt to the changing educational environment and implement innovative model of cognitive and play space. According to a number of scientists (Akour & Alenezi, 2022; Chou et al., 2021; Tatli, 2018), educational institutions of the future must be prepared to incorporate virtual cognitive and play space in order to develop children's readiness for learning from virtual reality games. The COVID-19 pandemic has quickly proved that the educational system would engage such digital transformation (Akour & Alenezi, 2022; García-Morales, 2021). And today no one is surprised that cognitive and play space gets virtual.

Presently there is a wide range of digital games. And they are available on large screens, handheld tablet, electronic learning systems, and electronic toys (Healey et al., 2019).

The application of virtual cognitive and play space promotes the enthusiasm of children and improves the efficiency of knowledge output. Digital games can build multiple different types of virtual environments in a limited space, adapt to the needs of young learners in various scenes and generate interesting interactions. In addition, virtual cognitive and play space is not limited by equipment or furniture. This interactive display enriches children's horizons and increases their imagination (Tang et al., 2019).

Modern technologies give the possibility to analyze the playing process and to respond properly. For example, software can record the time spent for playing, show game challenges and errors made. Also, electronic devices help to analyze the amount of educational content in the game, child's emotional responses, and their playing behaviour (Zhang et al., 2020).

We found that successful examples of application of virtual cognitive and play space were described for many countries worldwide like China, UK, New Zealand (Sun & Peng, 2020; Zhang et al., 2020), Taiwan (Chou et al., 2021; Sun & Peng, 2020), France (Guegan et al., 2021), Germany (Haferkamp & Dengel, 2021) and Israel (Shoshani, 2023).

Research Aim and Research Questions

The purpose of the article is to characterize trends, models, and cases of organization cognitive and play space in modern educational institutions and outline the most effective ones.

The article objectives are the following:

- to conduct a closed survey among teachers and to highlight the main trends and models applied in modern educational institutions;
- to describe the positive and negative features of common models of organization of cognitive and play space;
- to present the most efficient model of organization of cognitive and play space that can be applied at the educational institution of the future.

Research Methodology

General Background

In the article we used theoretical methods (analysis of scientific and pedagogical literature, synthesis of research results and the main trends of organization of cognitive and play space in modern educational institutions). Also, we applied the empirical methods of research like interviewing of focus group, pedagogical observation, and closed questionnaire survey. To process the data obtained during the pedagogical experiment the methods of statistical analysis were used.

Sample / Participants / Group

The pedagogical experiment involves 112 teachers of different educational institutions. The questionnaire was carried out in the Internet through Google forms. All the respondents agreed to participate in the survey voluntarily and they were informed about the research objectives and experiment procedures.

Instrument and Procedures

All 112 participants of the experiment (teachers from different educational institutions) are responsible for organization of cognitive and play space at work and actively implement play-based approach in the educational process. The questionnaire was carried out in the Internet through Google forms.

The respondents were interviewed to obtain quantitative and qualitative information on the problem. The questions were related the main trends for play-based approach at the educational institutions, the models of organization of cognitive and play space. Also, the teachers were asked to describe advantages and disadvantages for each of the models. The questionnaire contained the following questions:

- ✓ What educational institution do you work?
- ✓ What is your work experience?
- ✓ What category of children do you work with?
- ✓ How often do you use play-based approach?
- ✓ How is cognitive and play space organized at your educational institution?
- ✓ What model of organization of cognitive and play space is applied?
- ✓ Do you think this model is effective enough?
- ✓ What advantages for this model do you find?
- ✓ What disadvantages can you enumerate?
- ✓ What do you do to improve the situation in the future?
- ✓ Do you find the learners are motivated to play in this cognitive and play space? If not, why?

Data Analysis

Having collected the data we read them thoroughly, got a general sense of the information obtained and reflected on their meaning. The quantitative and qualitative data were analyzed for to select the most effective model of organization of cognitive and play space at the educational institution, based on the study of positive features we have outlined the type of cognitive and play space which can be applicable for the educational institution of the future. The results obtained during the pedagogical experiment are presented in the sections “Research Results” and “Discussion”.

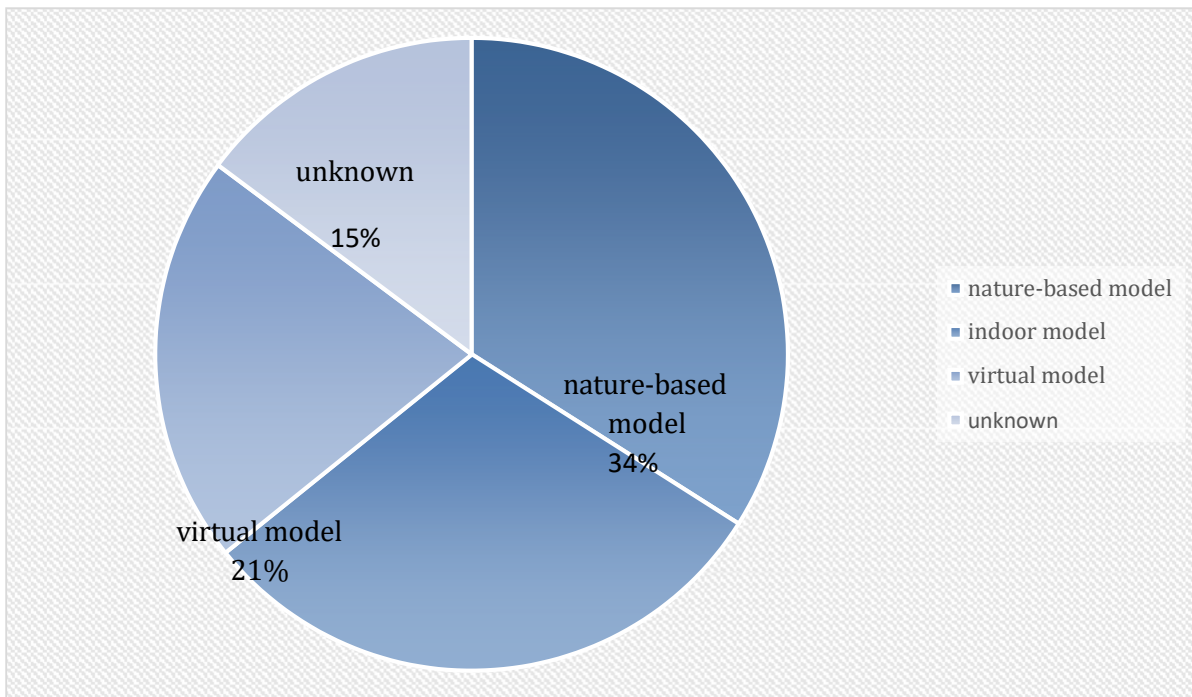
Research Results

The findings show that educators use three different models of cognitive and based or outdoor, indoor, and virtual.

Figure 1 shows the percentage of teachers of various educational institutions who prefer certain model of organization of cognitive and play space. These results suggest that the largest number (34%) of educational institutions use nature-based or outdoor play space to organize learning activities for children, almost the same amount (30,2%) of educational institutions prefer indoor cognitive and play space. 21% of schools apply virtual cognitive and play space fully or partially. 14,8% of educational institutions search for improvements of existing cognitive and play space. This number means that no model is ideal and it needs improvements for the future.

Figure 1

Application of Models of Organization of Cognitive and Play Space in the Educational Institutions



Source: author own development.

Each of the models described has its own advantages and disadvantages. Firstly, we will present positive (Table 1) and negative features (Table 2) of nature-based or outdoor play space. The respondents confirm that stimulation of creativity, development of imagination, encouragement to learning and teamwork are the most common positive characteristics of nature-based or outdoor cognitive and play space. At the same time, teachers claim that this model is risky for young learners especially in rural settings or in wild and untamed landscape, needs adult educators' control, depends on weather conditions, provides unusual and unpredicted conditions for learning and requires safety measures explanation to avowing dangerous situation.

Table 1

Positive Characteristics of Nature-based or Outdoor Cognitive and Play Space (Based on the Closed Survey)

Positive characteristics	% of the total number of teachers
Stimulation of creativity	89,2% of teachers
Development of imagination	87,1% of teachers
Encouragement to learning	82,5% of teachers
Encouragement of teamwork	80,9% of teachers
Increasing of problem-solving skills	75,2% of teachers
Improvement of physical health	68% of teachers
Development of independence	64,1% of teachers
Assistance to learn topography, vegetation, and other living organisms	58,3% of teachers
Formation of environmentally friendly behaviour	57% of teachers
Increasing of knowledge and understanding of the natural environment	56,8% of teachers
Development of cognitive sphere	56,2% of teachers
Formation of leadership skills	55,8% of teachers

Formation of resilience	54,7% of teachers
Improvement of young learner's attention	52% of teachers
Possibility to use animal-assisted learning	34,5% of teachers
Adventures and nature walks	34,2% of teachers
Formation of special skills like survival skills, etc.	33,9% of teachers
Enjoinment	33% of teachers
Appreciation for nature	31,8% of teachers

Source: author's own development.

Table 2

Negative Characteristics of Nature-based or Outdoor Cognitive and Play Space (Based on the Closed Survey)

Negative characteristics	% of the total number of teachers
Risky especially in rural settings or in wild and untamed landscape	67,4% of teachers
Needs adult educators' control	54,3% of teachers
Depends on weather conditions	54,1% of teachers
Provides unusual and unpredicted conditions for learning	53,7% of teachers
Requires safety measures explanation	50,6% of teachers
Challenging for children for the first time	43% of teachers
Requires more staff	37,5% of teachers
Possible absence of toys or special equipment	36,1% of teachers
Cannot be applied for big groups	35,7% of teachers
Requires joint responsibility between children and staff	34% of teachers
All activities demand preconditions for participation (like campfire or building a shelter)	32,9% of teachers
Some activities depend on physical development of children	24,5% of teachers
Can be tiring for some children	10,4% of teachers

Source: author's own development.

According to the results of the survey conducted among teachers of various educational institutions we have found that indoor cognitive and play space has a number of positive and negative characteristics. Tables 3 and 4 show the description of indoor cognitive and play space. The most common positive characteristics of indoor cognitive and play space are the following: adaptation to many subjects, possibility to use predictable and planned activities, application of special equipment. Besides this type of cognitive and play space allows children to interact face-to-face with their peers and teachers. The negative characteristics include necessity to use lots of equipment and facilities, application of flexible architecture decision and furnishing, lighting correction.

Table 3

Positive Characteristics of Indoor Cognitive and Play Space (Based on the Closed Survey)

Positive characteristics	% of the total number of teachers
Adaptive to many subjects	89,8% of teachers
Provides predictable and planned activities	88% of teachers
Applicable for urban and densely populated areas	87,5% of teachers

Allows to use special equipment	85,1% of teachers
Allows kids to interact face-to-face with their peers and teachers	78,8% of teachers
Develops cognitive potential of young learners	77% of teachers
Formations of communication skills	76,4% of teachers
Increasing of time management skills	73,6% of teachers
Improves self-discipline	73,2% of teachers
Teaches to apply self- and mutual control	72,5% of teachers
Formation of deep knowledge on different subjects	70% of teachers
Provides better interaction with teacher	69,3% of teachers
Social engagement of kids	68,9% of teachers
Improves information retention	61% of teachers
Possibility to organize QA sessions	55,8% of teachers
Possibility to use audio-and video materials widely	53,7% of teachers
Better surrounding to form self-esteem	41,4% of teachers
Possibility to use traditional textbooks	30,1% of teachers

Source: author own development.

Table 4

Negative Characteristics of Indoor Cognitive and Play Space (Based on the Closed Survey)

Negative characteristics	% of the total number of teachers
Requires lots of equipment and facilities	51% of teachers
Demands flexible architecture decision	50,5% of teachers
Lighting correction	50,1% of teachers
Similar surrounding every day	41% of teachers
Lack of physical activity	40,3% of teachers
Lots of stress for small kids	30,2% of teachers
Ventilation	29% of teachers
Boring	14%

Source: author own development.

Virtual cognitive and play space is also characterized by positive (Table 5) and negative features (Table 6). We found that positive characteristics include possibility to teach many subjects, formation of high motivation and interest among young learners, increasing of creativity. Negative characteristics of virtual cognitive and play space concern necessity to have special high-technology equipment and stable Internet access that makes it difficult for developing countries, formation of e- readiness among children, and preparation of special tasks and pre-tasks materials by a teacher.

Table 5

Positive Characteristics of Virtual Cognitive and Play Space (Based on the Closed Survey)

Positive characteristics	% of the total number of teachers
Applicable for many subjects	87% of teachers
High motivation	84,8% of teachers
creativity	83,4% of teachers
Problem solving	80,7% of teachers

Self-control	80,2% of teachers
Enhances learning capacity	80% of teachers
Interest to learning	80% of teachers
Readiness to real life where all services are digitalized	79,5% of teachers
Easy evaluation	78,7% of teachers
Feedback	75,3% of teachers
Safety during pandemic or in war zone	70,9% of teachers
Applicable for solitary play	65,2% of teachers
Training of survival skills like road safety skills, etc.	49,3% of teachers
Oriented towards technological development and innovations implementation	48,4% of teachers

Source: author's own development.

Table 6

Negative Characteristics of Virtual Cognitive and Play Space (Based on the Closed Survey)

Negative characteristics	% of the total number of teachers
Requires special equipment and stable Internet access	90,1% of teachers
Requires e-readiness among young learners	86,5% of teachers
Difficult for developing countries	84,2% of teachers
Needs special preparation of tasks by a teacher	75,3% of teachers
Needs administrator	65% of teachers
Information literacy	57,2% of teachers
Lack of psychological and social competencies	55,8% of teachers
Needs flexibility and blended forms	53,1% of teachers
Can be applied during short period	32% of teachers
difficult to distinguish the real from the fake	30,8% of teachers

Source: author own development.

Discussion

The analysis of scientific literature and the results of closed survey among teachers of various educational institutions prove that neither of the models of organizational of cognitive and play space is fully effective. In such circumstances we can talk about the hybrid or mixed model that will include the features of nature-based, indoor, and virtuals cognitive and play spaces. The hybrid cognitive and play space enables to use playing as an instrument to learn and to develop child's personality. And it is oriented towards their socialization and adaptation to real life as well.

Hybrid cognitive and play space consists of the physical and digital setting in which young learners play using all the toys and equipment, books and other things to be found in that facility. Besides the physical and digital setting, it includes the socio-cultural setting for such activities.

Playing and learning organized within indoor model is based on formal, intentionally planned activities. Playing organized outdoors is mostly informal in nature. Playing organized virtually is semiformal and applied through simulation and role games to train life competencies.

Hybrid cognitive and play space is a result of work of many construction experts (architects, artists, designers, builders, decorators), IT specialists, educational staff and parents who know what

their children like and what they need (Ernst et al., 2021). Sometimes children may be involved to arrange their space to make it comfortable. All components of hybrid cognitive and play space must be focused on stimulation of learning activity and personality development of a child in different conditions: outdoors, indoors, and virtually.

Effective hybrid cognitive and play space is a part of educational environment that is organized in specially designated area or virtually and equipped with materials or devices used for children development according to their age, mental or physical health.

The findings (Balari & Lorenzo, 2018; Deoni et al., 2021; Ernst et al., 2021) show that there is a number of requirements to organize hybrid cognitive and play space. These requirements must be considered while planning cognitive and play space at the educational institution of the future. They are the following:

- 1) The most important component of cognitive and play space is set of toys or various equipment, including present-day devices, that are necessary for formation of children's main competencies and contributing to their upbringing. Toys and equipment are arranged according to their functional features and type of play activity. Most toys and equipment must be multifunctional so they can be used in different ways.
- 2) Cognitive and play space must contain familiar things and new equipment which make children's cognitive development. A teacher may increase the number of toys and equipment gradually, given the children's knowledge and skills. Every new thing must be presented for the group with a surprise.
- 3) A teacher must calculate the amount of equipment, pieces of furniture like chairs and materials (sheets of paper, pencils, pens, toys, or books) for all the children.
- 4) The space must be of average size because small rooms are not enough for free play and children do not get the possibility to develop efficiently. And large facilities obviously lead to weakening of discipline and distract children's attention.
- 5) To use the space efficiently, it is required to remove all unnecessary things (for example, backpacks, outerwear, etc.).
- 6) Cognitive and play space must be attractive to children to draw their attention.
- 7) Cognitive and play space must be used regularly for the educational process. It will help to increase its efficiency and adaptation of young learners.
- 8) While playing all children must be involved in the activity.
- 9) Play must be free and spontaneous; indoor, outdoor or virtual.
- 10) Cognitive and play space is to support children's interests, to meet their needs and aptitudes.
- 11) Cognitive and play space must ensure free movement of a child within the designated area. They are allowed to move themselves, to move things and furniture.

12) A teacher must change the types of cognitive and play space regularly depending on learning objectives, children's mood, technical resources, and external situation.

13) Teachers are responsible for planning and facilitation of children's play and learning activity.

14) Before playing, a teacher must define objectives and rules to children to provide them safety and enhance the learning outcomes.

According to Bouw et al. (2021), Niemi et al. (2022), and Sun and Peng (2020) cognitive and play space at the educational institution must be organized in several stages. The first stage (preliminary) concerns specification of objectives and analysis of psychological, pedagogical, methodical, organizational, material and mechanical maintenance of the educational process. At the second stage (organizational) the project of cognitive and play space is designed. The third stage (analysis of situation) deals with identification of problems related to educational institution and children's objectives at the social and individual levels. The fourth stage outlines the methods to organize cognitive and play space for children. At the fifth stage (conceptualization) the concept of cognitive and play space is developed and educators outline the main activities will be used. The sixth stage (programming) is responsible for creation of programme of main events and activities oriented towards child's development and stimulation of cognitive sphere. The seventh stage (planning) means planning the organization of cognitive and play space and transition from monomodel to integrated mixed model. At the eighth stage (implementation) the plan is implemented with the educational process. The ninth stage (reflection) concerns the analysis and discussion of the space implementation.

Based on the analysis of the literature (Danniels & Pyle, 2018; Storli & Sandseter, 2019; Yuniastuti & Hasibuan, 2019), effective hybrid cognitive and play space suggests the realization of the following conditions that every teacher must consider: formation of positive contacts and friendly relations between children; recognition of child's success, correct activity, and creativity; realization of child's needs in positive and meaningful communication; organizational of various types of activities that contributes to child's self-affirmation, self-actualization and build self-confidence.

Thus, well-designed and properly organized hybrid cognitive and play space is a requirement for comprehensive, harmonious, and correct development of child's personality within the educational process. This fact must be considered for education institutions of the future.

Conclusions and Implications

A general analysis of the problem showed that organizational of cognitive and play space is very important for modernization of schools and building educational institutions of the future. However, the findings showed that the educational institutions currently apply three major models of organization of cognitive and play space: nature-based or outdoor, indoor, and virtual. The latter one is getting more important due to the experience of pandemic of COVID-19 or risk to appear in war zone.

The survey results showed that stimulation of creativity, development of imagination, encouragement to learning and teamwork are the most common positive characteristics of nature-based or outdoor cognitive and play space. At the same time, teachers claim that this model is risky for young learners especially in rural settings or in wild and untamed landscape, needs adult educators'

control, depends on weather conditions, provides unusual and unpredicted conditions for learning and requires safety measures explanation to avowing dangerous situation.

The most common positive characteristics of indoor cognitive and play space are the following: adaptation to many subjects, possibility to use predictable and planned activities, application of special equipment. The negative characteristics include necessity to use lots of equipment and facilities, application of flexible architecture decision and furnishing, lighting correction.

Virtual cognitive and play space is also characterized by positive and negative features. The findings showed that positive characteristics concern possibility to teach many subjects, formation of high motivation and interest among young learners, increasing of creativity. Negative characteristics of virtual cognitive and play space concern necessity to have special high-technology equipment and stable Internet access that makes it difficult for developing countries, formation of e-readiness among children, and preparation of special tasks and pre-tasks materials by a teacher.

We have come to the conclusion that in modern circumstances the hybrid or mixed model is the most effective. The main requirement to hybrid cognitive and play space is that all its components must be focused on stimulation of learning activity and personality development of a child in different conditions: outdoors, indoors, and virtually.

The results demonstrate that well-designed and properly organized hybrid cognitive and play space is essential for comprehensive, harmonious, and correct development of child's personality within the educational process. The research showed that hybrid cognitive and play space is the most effective model for the education institutions of the future as it is characterized by dynamism and multifunctionality.

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An Analysis of the Digital University Phenomenon: Dilemmas, New Opportunities

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Abstract: Universities are institutions with a long history and have undergone many changes over the centuries. In recent years, these changes became significantly visible. This is due to the rapid development of technology. The digitalization has a major impact on the university's functions performing. But these processes are not linear or simple but are evolving into complex, ambivalent, and contradictory processes. Digital universities have reasonably taken their place in the education system. Together with the increasing of workloads, bureaucratization, the need for marketing control, the need to reduce costs, large-scale savings, these structures have developed active accomplishments using all channels and filling all possible variants of codes and formats, numerous and diverse actions, managed by digital and technological support. The purpose of this paper is to analyze the most relevant effects and dilemmas of the implementation of digital technologies in university education and research from the socio-material point of view of the phenomenon of "digital university". At these terms one proposes an analysis that goes from the particular to the general is conducted. First, the effects of digitalization on teaching and research are analyzed, some ideas about the possible future associated with digital technology are developed, and finally, some ideas about how to analyze the impact of technology in the university from a critical point of view are offered.

Keywords: digital university, information and communication technologies, technological change, digital pedagogy.

Introduction

The university as a concept has a long history. Over the centuries, this educational structure has adapted to socio-political conditions. However, the concept of higher education, its functions, applicants, etc., has changed in the context of scientific and technological progress and geopolitical processes. These processes have radically changed both the concept of universities and the goals of education itself. Universities are considered to be a key factor in every country's economic development and global competitiveness. Nevertheless, the means of achieving educational goals allow and improve with digital information and communication technologies (Brolpito, 2018). At the macro level, the phenomenon of digitalization of universities is understood broadly as the reorganization of social, cultural, and economic structures and relations, motivated by the generalization of digital information and communication technologies in all areas of human activity within modern society (Alkhowailed et al., 2020). At the micro level - first of all, its perception by the subjects of learning.

The modern university is looking for its place in the information society. However, a strategic mistake made by the leaders of modern universities is the formation of powerful IT systems and ignoring business strategies adapted to the digital era (Alzahrani et al., 2019).

Research Problem

Institutions in which a fundamental part of existence has always been the presence of educators, in the perspective of digitalization, are linearly changing in nature (Bygstad et al., 2022). In a highly competitive environment for students, digital universities are created. The classical university is transformed into a multifaceted, new structure with positive and negative sides. The conflicts and contradictions of the positions of the digital university occur primarily on the replacement of the values of previous generations (Xuetong, 2020). Being aware of the striking number of transformations caused by the implementation of digital technologies in the university and the change in people's activities in this context, we can talk about the changes in the social composition of the university.

Research Focus

In this paper, we propose a socio-material approach to the analysis of the phenomenon of the digital university. We focus on questions of how the relationship between subjects and objects (understood as being one and indivisible) affects the functioning of the digital university (Fuchs, 2020). We consider educational technologies that achieve certainty, functionality, and value only in the pedagogical models they promote, the forms of social relationships they build, and the educational goals they seek to achieve (Mosteanu, 2020b). Analyze the impact of technology together with the principles, processes, and parameters of design, implementation, deployment, and use that underlie the digital university and are the result of human decisions.

Research Aim and Research Questions

The work aims to analyze the most relevant effects of digital technologies in the university, an analysis that will offer alternatives to their usual use and predict its future reactively and proactively. The aim of the work predetermines the objectives: analysis of the impact of digital teaching; consideration of the impact of technology in the university from a critical perspective; general overview of issues of public management and hegemony in university governance in the digital era.

Research Methodology

The paper analyzes the learning opportunities and dilemmas in the digital university in the face of technological changes in material and functional terms, which are striking at the moment. From the perspective of the above, the paper analyzes in a systematic way the impact of the introduction of technology on the learning process. These configurations are considered within a material-functional and social perspective. From a social (or human) perspective, the classical university has changed radically. Due to space constraints, it is impossible to return to attitudes concerning the universality of e-learning or the introduction of virtual classes in universities. The paper focuses on practices that have become trending in the last 5 years. One of the complex concepts of higher education in recent times is the personal learning environment (PLE). The paper defines PNS as a socio-material structure of which each individual is a part, while a formal education is part of a larger whole that must be controlled and self-regulated individually. Some of these challenges proposed by PNS concern changes in the role of participants in the processes of learning, with the organization of teaching. The methodology of the work

includes a critical analysis of the main aspects of digitalization, namely the consideration of: the development processes of university information technology; new ways of project management; the specificity of digital universities in general.

Research Results

The Origins and Phenomenon of the Digital University

The Digital University is an entire association composed of thematic digital universities whose vocation is to make available to higher education institutions (faculty, students) digital educational resources for teaching (flipped classroom, face-to-face classes, supplementary resources, distance learning, etc.). The technical and pedagogical quality of these resources is verified by scientists competent in each disciplinary field. These resources are free and publicly available in most cases. The digital university includes the following areas of study: Health and Sports, Engineering, Economics and

Management, Humanities (Arts, Literature and Languages, Humanities and Social Sciences), Environment and Technology Development. The Digital University focuses on the entire university community: faculty, students and serves to provide a pedagogical complement to teaching, management, development, and implementation of digital policies.

Thematic Digital Universities (UNTs) were first established in 2003 by the Ministry of Higher Education in Europe. For example, French digital universities are not traditional university institutions, as they do not count students and do not grant degrees or diplomas. Despite their different organizational and legal forms, they are groups of higher education institutions that produce, disseminate and interact with the support of the state by providing digital (free educational) resources. Digital universities were subsequently coordinated in the form of the 1901 Association Act. Beginning in 2019, their number began to grow significantly. One digital university is capable of integrating more than one hundred institutions of higher education and research (Doroshenko et al., 2021). Digital universities were created to unite and promote the use of digital technologies during classes in higher education. This association involves the production of digital educational resources, most of which are freely available through websites. These resources are intended to assist faculty in their work, thereby contributing to renewed pedagogy and digital innovation in higher education (See Table 1).

Table 1

The Main Tasks of Digital Universities

New possibilities for digital universities
1. Supporting students from the beginning to graduate school, supporting them in mastering their first foreign language L1, to increase their level of success in the job market.
2. assistance in orientation for applicants.
3. Advocacy for lifelong learning.
4. Dissemination of knowledge for the development of the country.
5. Promote distance learning, especially for people who cannot attend (people with disabilities, skills in war, prisoners, etc.).
6. Promote digitalization and support institutions to implement applications related to digital pedagogy.

- 7. Co-creation and management of multi-partner digital-oriented projects.
- 8. Promoting international mobility and integration of international students.

Source: formed based on the author's analysis.

The phenomenon of the “digital university” is a shared vision of the future of education and digital pedagogy. It aims at developing collective actions, projects of production, and re-engineering of resources for the audience, and promotion of the actions of each institution of higher education.

Elements of the Digital University Model

Digital universities provide and distribute many educational resources, often partially funded by the state. They are also available for general use. Among the elements present in the digital university, we single out the following: digital library, digital campus, electronic student card, electronic dean's office, information system of management of the university catering point, university boiling point (space for teamwork), the introduction of educational disciplines using AR and VR and virtual simulators, development of online courses by the leading world MOOC platforms, “digital diploma” model based on blockchain technology, development of courses supplementary to the digital university. Let us describe the main objectives of the highlighted elements of the digital university (See Table 2).

Table 2

The Dilemmas and Goals of Digital Universities

Purposes	Details
Legal policy	Help with non-credit modules. Facilitating students who were not allowed to attend.
Protection of interests	Promoting the integration of students with disabilities
Professional support	Preservation of rare disciplinary knowledge and skills. Supporting the transformation and implementation of the learning offer.
Development of partnership	Supporting the evolution of pedagogical practices, including through digital technologies. Creating or participating in multi-partner projects.

Source: formed based on the author's analysis.

We believe that digital universities contribute to the renewal of pedagogy by promoting pedagogical creativity through the use of digital technologies. They have become key players in pedagogical transformation through digital technologies and complement their work and contributions.

Digital technology drives innovation in higher education

In the last five years, digital technology has formed the basis of the strategic response of Ministries of Higher Education. The present digital strategy was launched together with the emergence of the Covid-19 pandemic with two goals: to ensure the proper functioning of universities and to promote student success in a crisis (Alkhowailed et al., 2020). The growth of digital technology every day offers new opportunities for innovation and transformation of higher education. In a fast and changing world, higher education institutions are engaged in a pursuit of innovation: they are constantly rethinking their

pedagogy, renewing their infrastructure, and finding new ideas to offer their students a better learning experience. The goal is often to be national and international leaders. In this respect, the most significant innovations of the digital university stand out as follows (See Table 3).

Table 3

A Brief Overview of Important Digital Innovations in the Higher Education Sector in Recent Years

Innovations	Description
Massive open online courses	Open online courses are offered by institutions of higher education around the world. These are free trainings that allow any student to become a participant. A certification system exists for certain courses and requires a financial contribution. Topics are often varied, from math to social sciences to personal development or health. These courses, open to all, democratize access to knowledge. They are a godsend for students

Source: adopted from (Doroshenko et al., 2021).

In the context of the new possibilities of digital universities, the dilemmas associated with this phenomenon should also be identified. As the “education of the future,” digital universities carry significant weight in terms of information transfer and are especially suitable for people who already have certain competencies in the traditional learning system. For a mature person, for example, it is more appropriate to take part in an online refresher or retraining course than to actually travel to a learning space. For those who are at the beginning of the learning process, attendance is indispensable. Even so, the intertwining and correlation between the traditional and digital university should be assumed. As the administration of information or educational records by virtual means, especially the teaching component, digitalization is indispensable. Regarding the physical learning process - the pedagogical relationship cannot be replaced by computer tools that create the illusion of human relationships. With digitalization, education can manage the learning process, in part covering the requirements of distance learning, considering the sudden transition, the completeness, and the novelty of the teaching-learning experience. But anyway, not all universities are ready to go digital for lack of understanding that they are dealing with a completely “new consumer”, because of the failure of financial implementation of the introduction of new methods and because of the lack of trust in new technologies.

Discussion

In the context of the dilemma Floridi (2020) puts forward the idea of an important trigger for the use of digital resources in universities - digital literacy. That is, building knowledge, skills, and confidence in using new technologies and devices to achieve an educational goal. Aagaard (2020) calls the transition of education to new media and communication atypical and unnatural. According to the scholar, this forced experiment, national and global, will leave deep traces of what must happen at the level of many components - organization, technology, curriculum, learning management, etc., and offers a stage-by-stage assessment of this dynamic process from within, relying on the necessary filtering further evaluation of the phenomenon of the digital university. The option of online learning and the emergence of digital universities is a solution to crisis situations, but not an alternative to what

education is intended to achieve in conventional settings (Aitchison et al., 2020). A similar view is expressed by Brown and Green (2018). The authors consider digital universities as an attempt to maintain and continue the presence of the university with a substitute that can only be perpetuated in a consistent and tendentious way, given the ratio between effort (multiplied by faculty and students) and the effects achieved (half or even a quarter). In contrast to this assertion, Lazar (2022) believes that the digitalization of education is meant to edit the natural process, translated and reduced by the limits of crisis frameworks. Digitalization of education cannot be criticized or abolished but must be accepted and realistically materialized if conditions require it and it is hardly the only option to preserve the educational process. According to Ma and Feng (2021) education, always and everywhere, is conditioned by context, by definitions. A true educational system, in that it has its basis, is carried out in relation to some value constants, procedural or substantive, beyond the conjuncture and the incidental. Beyond time or event, it is desirable for education to be technically enabled and digital universities in this sense are life-saving structures (Martzoukou et al., 2022). Regardless of the indicators of the technical base, the abilities of the teachers, the propensity of the teaching content to recode didactically in relation to the new context, the process of teaching, learning, evaluation is diminished, it loses consistency, quality, naturalness. Not all dimensions of education can be covered by the new formula: relational dimension, cooperative dimension, objective implementation of assessment and feedback, monitoring and performance incentives, individualization and personalization of learning suffer (Sayaf et al., 2022). Digitalization of education and the implementation of digital universities is not only the use of technology. IT processes and management must be properly regulated (Mosteanu, 2020a). All successful changes and implementations must have clear visions and strategies. Universities must invest in providing staff, academics, and students with the necessary training in digital technologies and combine them with effective support networks (Floridi, 2020). Solidarize, because there is no specific way to achieve educational outcomes through digital technologies but listening to education actors can provide valuable insights and experiences. By enabling working institutions to test new ways of working with digital technologies, with the necessary support, the digital university can turn from a phenomenon into a reality.

Conclusions and Implications

Today, digitalization is affecting all productive sectors of the social spheres. Trends toward the progressive digitalization of higher education have been particularly active over the last five years. The digital university is a field of the latest ideological battle. But conflict must give birth to proposals. And to enter this field, it is important not to lose sight of their three main characteristics:

1) the digital university phenomenon is a socio-technical imagination, a vision of the desired future that is collectively supported, institutionally stabilized, and publicly executed;

2) the digital paradigm is changing. The digital context has become a common characteristic, evolving in unpredictable ways. In higher education we are talking about profound changes, which in turn lead to didactic consequences;

3) the digital university is a socially material reality. That is, the digital university aims at defining the practices of teaching, research, management, and dissemination of knowledge. And it is necessary to take into account the networks of each actor (people, technologies, norms, etc.) constantly building and reconstructing these practices. After all, we should not forget that technology is created, developed, and implemented by people with specific interests and needs. For the same reason, they are receptive

to change, more critical, democratic, open, and flexible practices. The digital university is the product of a complex relationship established between technology, people, and educational standards. The university today is already digital, although it does not yet offer anything significantly different from the classical university.

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Information Technology and Management in Higher Education and Science

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Abstract: Today IT is one of the most important factors that has a strong impact on the education and science system quality in the whole world as well as in Latvia. The basis of the use of information technologies in higher education and science research is the system analysis qualitative combination of methods. During the research the existing base of scientific literature, methods of analysis, synthesis, induction, deduction, concretization, methods of generalization and analogies were used. As a result of the research, it was found that the introduction of information technology in the field of science and higher education is of great importance for the actual development in these fields. It will be helpful for the professional training of specialists capable of developing selected spheres and competing in the modern labor market. In the course of the research, the main indicators which conduct to the increasing the level of information literacy were identified. A number of advantages and disadvantages of information technologies in the scientific and educational sphere use are highlighted. One identified the main tasks of using information technologies in the field of science and higher education. The main advantages of information system in the process of learning in higher educational institutions use are highlighted. The results of the research are of great practical importance, as they can be used as a basis for further work in this direction.

Keywords: higher education, information technology, science, development, implementation.

Introduction

Information technologies, electronic services, social networks, the Internet have entered into almost all spheres of society. The introduction of information technologies into the life of society has led to their widespread use in the scientific and educational fields. The UN report on human development notes the emergence of new technologies with the development of human potential.

From the point of view of science and higher education, virtual space becomes an information space, a place for students' knowledge monitoring as well as electronic journals are used for posting the marks. The global computer learning market, according to the Gartner Group (a research and consulting company specializing in information technology markets), is growing at approximately 13% per year. A system of distance learning (DL) in higher educational institutions has wide development, which provides the acquisition of knowledge using distance learning technologies, i.e. computer technologies. Namely, thanks to computer communication, hybrid fields of science are created, which is expressed in citation and in the mutual use of methods from different disciplines, which leads to the standardization of knowledge (Kalyanaraman et al., 2018; Chergui et al., 2020). At the present time information technologies have become a priority in the modern development of science and higher education and are attractive for applicants and scientists when choosing a higher educational institution, i.e. information technologies lead to promising changes in higher education in general and determine the competitiveness of universities in the market of scientific and educational services (Chauhan et al., 2021).

Research Problem

Today, information technology is one of the most important factors that have a strong impact on the quality of the education system both in the world in general and in Latvia in particular. As the main problem of the research, the features of the use of information technologies in higher education and science are highlighted.

Research Focus

This study is focused on identifying the features of the disadvantages and advantages of introducing information technologies in higher education and science.

Research Aim and Research Questions

The main purpose of this article is to study the features of the use of information technology in higher education and science.

Research Methodology

The choice of specific research methods is in connection with the nature of the factual material, the conditions and objectives of this research. The selected methods are an ordered system in which their place is determined in accordance with each stage of the research of the application of information technologies in higher education and science, the use of techniques and operations with theoretical and

factual material in a given sequence. The research of the features of the use of information technologies in higher education and science is based on a qualitative combination of methods of system analysis. In particular, the following methods were used in the study: analysis, synthesis, induction, deduction, concretization, generalization methods, analogies and mathematical methods. The basis of research is the work of famous scientists. Despite the achievements in the field of application of information technology in education, the conceptual foundations of information technology support for education, taking into account the specifics of the introduction of modern information tools in education and science, as well as influencing the further development of scientific and educational systems, are currently insufficiently developed. The purpose of this article is to study the features of the use of information technology in higher education and science.

Research Results

The beginning of the 21st century is rightfully considered the stage of active development of the absolute information technology industry. The characteristics of the current stage of the higher education system in the world in the context of the development of information technologies are presented in Table 1.

At present time, an innovative strategy for organizing training is an integral part of not only domestic education, but of all world system of education in general, which in turn contributes to improving the quality level of the education system. The activity of a modern person is hard to imagine without information technologies, thanks to which it is possible to obtain the necessary information, its introduction into the spheres of the economy, public consumption, production, education and science. The problems of pedagogical expediency of use, analysis of prospects, possible aspects of the development and implementation of information technologies in the educational system are studied in many scientific works. Dudar et al. (2021) correctly noted and made an in-depth emphasis on the possibility of using information technology in education. He proclaimed the idea of combining technical and pedagogical sciences, as a result of which it is possible to build a perfect technical or industrial pedagogy.

The psychological and pedagogical aspects of the use of information resources in the scientific and educational field were studied in detail in the works of Penprase (2018). In his developments, he focuses on the computer as an important tool for improving the effectiveness of learning, the development of human psychology, but at the same time emphasizes the importance and weight of pedagogical work, replace which is not subject to the computer with the greatest desire. Only the teacher is given to become a full-fledged mentor for the student. At all times, the teacher's word has been famous and famous, with the help of which he teaches, develops and educates the younger generation in the face of students. The computer only contributes to the harmonization of the relationship between the teacher and the student, due to which a higher level is achieved in the scientific and educational process (Penprase, 2018).

Table 1

Characteristics of the Current Stage of the System of Higher Education in the World in the Context of the Development of Information Technologies

Category	Characteristic
Information revolutions	Currently, the formation and development of cross-border forms of information and telecommunication Networks
Evolutionary stages of the educational system	From 2012 to the present, globalization and mass character
Educational revolutions	Distance and e-learning
Characteristics of the educational sphere	<ul style="list-style-type: none"> - since 2012 - the creation of massive open online courses. - Availability of alternative courses - sources of knowledge of the highest quality . - Education has become pragmatic - Recognized educational hubs appear (USA, Australia, UK, etc.) - It becomes prestigious to get an education in another country - There has been a transition from knowledge, skills to competencies - A large flow of information is contained on the Internet, including unverified and - incorrect information - Knowledge Triangle - Diverse missions of universities in the knowledge society
Learning Outcome	Citizen of the world. A professional capable of learning on his own throughout his life
University Success Criteria	Number of foreign scientists and students Availability of fundamental research. Reputation in the academic and professional - environment. Commercialization of research results

Source: grouped by author.

The totality of the latest electronic computing and telecommunication tools that ensure the collection, storage, processing, expression and use of information form a single system called "information technology" (Poveda-Pineda & Cifuentes-Medina, 2020). From the standpoint of another contemporary scientist, Fuchs (2021), the term "information technology" is perceived only as a harmonious symbiosis of ways and means that favorably contribute to the increase of human knowledge and abilities to use technical and social devices.

Thanks to the advanced technologies of the countries of the world community, there is currently a picture of the active use of the latest information resources in almost all fields of activity: in the economy, science, aviation, ecology, etc. At the same time, for the subsequent competent application of these technologies in practical activities, a person must receive a professional high- quality education. It is in the concept of "education" that the fundamental basis of all knowledge, skills and abilities necessary in further labor practice is laid (Qureshi et al., 2021). Watching the pace of evolution of the information society, we increasingly understand the inevitability in the advanced methods of education, because. it is impossible to achieve the desired result in the training of highly qualified specialists with one traditional form of education. The practice of dynamic introduction of information and communication technologies into the educational process demonstrates the possibility of exchanging experience with the world's leading universities, as well as attracting the best teachers for internships.

According to the report of the American Library Association, absolutely all sectors of society must be information-savvy so that, if necessary, it is possible not only to apply specific information, but also

to detect, identify and evaluate it (Keržič et.al., 2021). Subsequently, the theory of information literacy received broader analytical research, which allowed the individual to adapt in the field of constantly modernizing information technologies, in addition to using existing ones, as well as the ability to understand information production in general. In scientific and educational activities, the information competence of a teacher and a student serves as a fundamental basis not only in obtaining information, but also in its exchange, readiness to apply in practical life (Bond et al., 2021). In the course of the research, the main indicators conducive to increasing the level of information literacy were identified:

- understanding the need for information;
- an attempt to fill the information gap;
- formation of search tactics;
- the ability to find the necessary information;
- availability of access to information;
- processing and comparative analysis of the received information;
- the ability to apply or convey information depending on the situation;
- creativity to new discoveries through already existing information.

On the basis of the research, it was found that both the quality of the entire educational process and the facilitation of finding and collecting information play the main role in improving the information literacy of teachers, which will make it possible to convey information to students in the most correct and accessible way. A necessary criterion for improving the effectiveness of teaching methods is the latest information technologies application to education.

Currently, all new information technologies are being actively developed and created for the purpose of accessible education of the younger generation. Therefore, the teacher, first of all, should systematically improve knowledge in the field of information communications, raise the level of information culture, while not abusing these technologies in their practical activities, but treating them with a creative approach. Media means and methods, as the latest achievements of modern science, are a source of professional growth and self-improvement of a teacher (Cabaleiro-Cerviño & Vera, 2020). According to the author, the modernization of the educational process primarily consists in replacing the outdated teaching methodology (lecture practice) with a more advanced teaching system (research activities, independent work). At the same time, the global problem of higher education institutions is the reduction of teaching hours allocated to subject disciplines, in relation to the growth in the scale of information. And the so-called "information reform" has had and is having a beneficial effect on the degree of students' preparation, thereby expanding their horizons and worldview (Escorcía Guzman et al., 2022).

Awareness and solution of the problem of informatization of educational activities in higher educational institutions is reduced to the desired result. Based on the research, it was found that thanks to computer technology, it is provided:

- assimilation of a huge format of information;

- simplified access to the necessary reference literature;
- choosing a dilemma with respect to a similar point of view;
- professional approach to solving the questions or tasks;
- comparative analysis with alternative options.

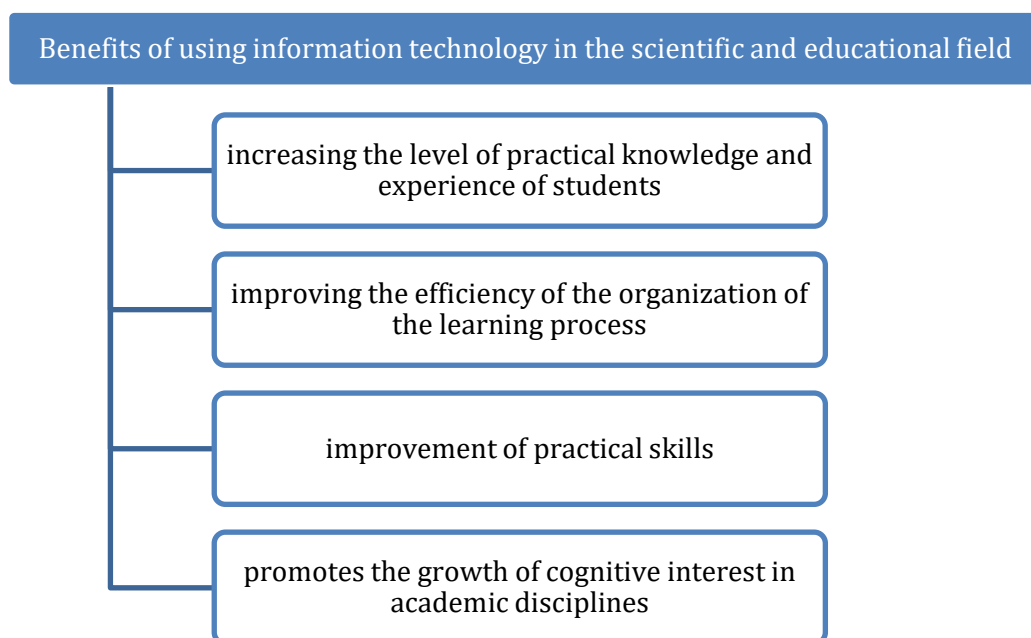
Therefore, it is very convenient and comfortable in the scientific and educational field of activity to systematically resort to the help of electronic technological resources, which in this regard must be steadily improved and updated.

At the same time, in the leading circles of higher education institutions, there is doubt about the acceptability of the phrase “educational technologies” today. Usually, we can hear about information or communication technology. Together, these technologies are aimed at solving more global problems, or rather, at creating new educational models in which information, communication and computer technologies will be harmoniously combined with the educational process (Escorcia Guzman et al., 2022).

Information technologies, widespread in the educational environment, help to meaningfully develop academic disciplines, interacting with other related subjects. Thus, science is “equipped” with new discoveries, achievements and knowledge, which in turn contributes to educational progress and an increase in the level of students' knowledge (Megnounif & Kherbouche, 2020). The research identified a number of advantages that the use of information technology in the scientific and educational sphere has, these advantages are presented in Fig. 1.

Figure 1

Benefits of Using Information Technology in the Scientific and Educational Field



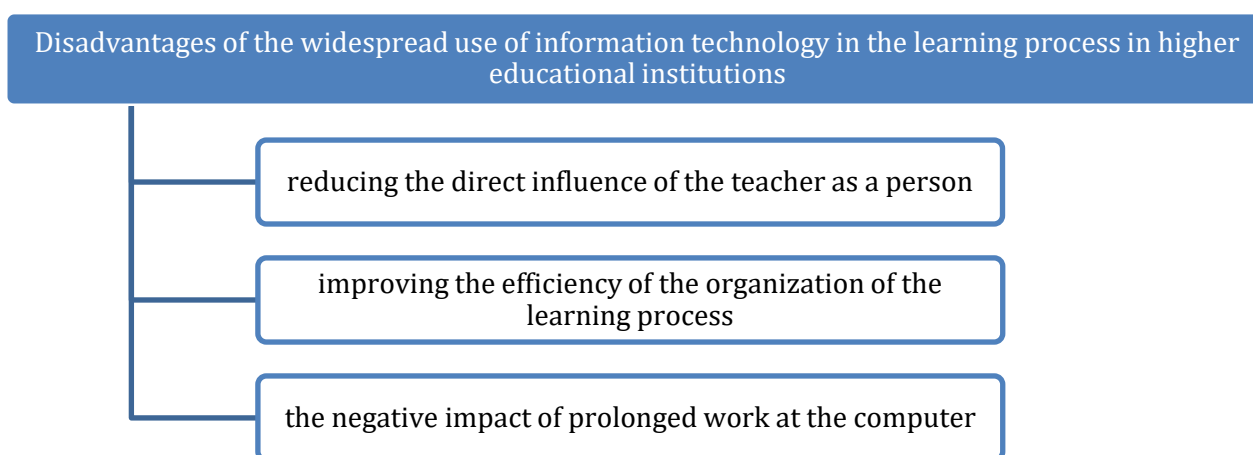
Source: grouped by author.

The advantages of information technologies in the learning process are indisputable, since they act as universal moderators of visual learning of the material, combined with logical thinking. This is the main purpose of information technology, as student can be easily involved in the educational process and successfully trained, because information is presented using accessible methods in audio and video formats (Marinoni & Jensen, 2020).

But the widespread use of information technology in the learning process in higher educational institutions is not without certain drawbacks (Fig. 2).

Figure 2

Disadvantages of the Widespread Use of Information Technology in the Learning Process in Higher Educational Institutions



Source: grouped by authors.

Thus, it was found that information technologies perform an important function not only in strengthening the educational foundation, but also in improving the quality of science and education. Thanks to the improvement of information technologies, access to educational programs of various levels and standards is increasing up to the international format (Krassadaki et al., 2022).

Modern information technologies introduced into the scientific and educational sphere allow teachers to qualitatively change the essence, methods and methodological forms of the educational process in higher education. In the course of the research, the main tasks of using information technologies in the field of science and higher education were identified, the results obtained are presented in Fig.3.

Figure 3

The Main Tasks of Using Information Technologies in the Field of Science and Higher Education

The main tasks of using information technologies in the field of science and higher education



- increasing the intellectual potential of students in the information society;
- in the direction of the educational system and the entire educational process in the direction of improvement, the formation of relationships between the student and the teacher, based on respect for the rights of each person;
- support and development of individual potential, of each person, laid down by nature;
- improving the effectiveness of both scientific and educational processes;

Source: grouped by authors.

In the process of educational and methodological work, most teachers with great pleasure resort to the help of the latest information technologies, taking into account their importance in the educational field. However, the procedure for increasing the effectiveness of the use of information in society with the help of advanced information technologies is consistent and systematic. Information technology today is a means that complements the mechanism of education, and mandatory installations of a modern educational institution (Pei et al., 2022). Thanks to the qualitative development of information technologies, it becomes possible to improve the education system, as a result of which millions of people can receive free education of the highest level without any big costs. That is why, in the name of creating and modernizing an innovative educational platform, it is advisable to consider the use of electronic information technologies in the educational process from a strategic angle (Escorcia Guzman et al., 2022). In many developed countries of the world, including Latvia, the educational field of activity in higher educational institutions is presented in the format of information resources of remote access. The very nature of technological novelty is aimed at the use of information tools in education in order to prevent the emergence of contradictions, as in traditional education.

In the course of the research, a number of contradictions were identified, the elimination of which is aimed at the introduction of information technologies in the field of higher education. The research showed that the main among such contradictions are:

- increasing the level of theoretical knowledge, but lack of skills in their practical application;
- the potential threat of doubts in the conclusions and assessments, leading to a loss of flexibility of thinking;
- rapid turnover of updating educational knowledge and its low actualization in practice;
- lack of a clearly defined creative and innovative orientation.

It can be argued that in the educational field of activity of higher educational institutions, information serves as an innovative core for strengthening the student's position and mastering not ready-made material, but independently obtained in the process of research and analysis of electronic

information resources. It follows from this that along with the teacher, the student is also responsible for systematizing of information resources.

Technological innovations in the educational sphere of higher educational institutions play a high role. The inclusion of the latest information and communication technologies in scientific and educational work, the massive use of leading information resources entails considerable financial investments, but it creates prospects for improving the quality of education, thereby ensuring the demand for a higher educational institution at the fair of educational services (Rapanta et al., 2020).

The main merit in achieving high results in the education and training of students belongs to the close-knit team and well-coordinated work of the university, built on the principle of trust. Consequently, decisions are made by the management together with the university staff, and then they are already implemented by the information and technical service of the university.

Thus, it can be argued that the information system used in the learning process in higher education institutions has many advantages:

- firstly, all the necessary information for the successful operation of the institution can be grouped and organized into a single file or folder;
- secondly, it provides convenient and quick access to information from other departments. To do this, you need to make the right request in the "find" window, and the information of interest after a certain waiting time will appear on the monitor of the electronic device. Thus, the introduction of information "know-how" in the educational sphere of activity of higher educational institutions facilitates the work in the management of an educational institution.

Discussion

According to scientific research, there are four fundamental aspects for the introduction of information technologies in the system of science and education: social, professional, pedagogical and catalytic. The social aspect is determined by the priority of information technology in the life of society (Freitas & Paredes, 2018). The professional aspect is the need to prepare students for professional activities that require certain knowledge when using computer technology. The pedagogical aspect is that technologies are introduced into the learning process, which determines the wide possibilities of communication and better materials, which enhances the teaching of traditional subjects. The catalytic aspect predetermines the improvement of teaching, administration, management, having a positive impact on education in general and changes the authoritarian relationship between teachers and students.

Rapanta (2020) notes the following benefits from the introduction of information technology in higher education:

- Strengthening the overall student motivation;
- Transition from passive to active learning;
- Improving the quality of teaching;
- More simplified student access to educational materials.

In April 2019 an international scientific and practical conference "Modern information and communication technologies in higher education: new educational programs, pedagogy using e-learning (computer learning) and improving the quality of education" was held at the University of Rome "La Sapienza" (Italy), where topical directions for increasing the competitiveness of modern universities were considered: the integration of innovations in education and research; academic mobility and networking of universities; international cooperation and new demands of the labor market. Consideration of these aspects at the European level highlights the role of the use of computer technology in teaching in universities (Poveda-Pineda & Cifuentes-Medina, 2020).

In world practice, new trends in the training of a multilingual specialist are also emerging. And English is a priority in connection with its use in the organization of computer training (software in English). "When students work in stable and dynamic dyads, the level of language competence sharply increases" (Gorozidis et. al., 2021). In this regard, the use of computer technology in the study of English is currently very relevant and important, and this leads to an increase in the amount of independent work of the student, since there is currently a large selection of ways to search for information, for example, it can be an electronic textbook or search engines such as Google, Google schools, Base (academic information search), Yahoo, Refseek (academic information search), Informine, Ask, Bing, MSN, etc., and it is best to choose the right search engine taking into account the following aspects - ease of use of the search engine, the quality of the results and the timing of finding the results. There are also many electronic dictionaries, such as Multitran (one of the best) and Lingvo. On the Macmillan website, you can even get into a virtual room where you can interact with the community. The participation of students in electronic testing (control of residual knowledge, or intermediate control of knowledge) can also be attributed to the independent work of the student, with the obligatory presence of a training test in the Academic NT system for pedagogical assessment at the university. But with all the available information resources, there are also certain difficulties in introducing computer technologies in the study of any discipline, which lie in the fact that it is necessary to observe the principle of an individual and differentiated approach in teaching students, and it is also necessary to compose electronic tests in accordance with the curriculum, while within the framework of computer testing, it is possible to take into account the level of training of students and develop test tasks of varying degrees of complexity (Ozdamli & Cavus, 2021). Given the existing difficulties, the use of new information technologies in teaching predetermines a more active position of the student himself in the process of mastering knowledge and in the scoring system, since a student, having Internet access via a mobile phone, can instantly find out his results of midterm tests and see their rating marks, put down by the teacher for the module according to the training program (Tartavulea et al., 2020). At the same time, the spirit of competition appears among students, which leads to an increase in their activity and to an increase in the overall student motivation. And also, a new type of cognitive activity using information technology requires students to focus and attention, which contributes to the development of cognitive independence and student confidence and leads to the formation of skills to independently replenish their knowledge, search for information and navigate in a huge flow of information, which improves the quality of knowledge. As well as the interactivity of students and the actualization of their tasks is achieved by using video presentations at scientific conferences of the university with a focus on the practical activities of future competitive specialists in the labor market. Thus, it is impossible not to agree with the statement of Bill Gates that investments in electronic infrastructure and education are the key to ensuring the future competitiveness of the economy of any country.

Conclusions and Implications

Thus, as a result of the research, both positive and negative aspects of the use of information technologies in the educational process were identified. Among the positive aspects of the use of information technologies in science and higher education, we highlight the following: a significant simplification of the learning process, increasing the intellectual potential of students, strengthening the degree of learning at all stages of the educational system.

As for the negative impact on the educational process, this is viewed through the prism of the problem of the relationship of information. For example, a computer has a large amount of information and data, and students are not physically able to master all this material in a short period of time. Most scientists of our time regarding the theory of the possibility of replacing human communication with computer learning agreed on the following opinion: a computer is not able to transform into human communication, learning the inner worldview, judgments and thoughts. In this situation, it is very important to correctly approach the system of vocational training, in which the computer occupies the position of an auxiliary element, but in no case replaces the live communication between the teacher and students. As a result of the research, it was found that the introduction of information technologies in the educational process contributes to the following:

- easy access to information that is freely and openly available to potential users;
- simplified search for the necessary information, which in modern conditions requires less time and money;
- an increased degree of students' interest in mastering the educational material, further analysis and subsequent application in practical professional activities.

Without the active use of modern information technologies in the scientific and educational process, intensive innovative renewal of science and education systems is impossible. It is thanks to the wide use of the latest computer, telecommunication tools and information resources of the developed countries of the world that the level of professional training of graduates for life and work in the modern information society increases in higher educational institutions.

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Forecasting the Prospects for Innovative Changes in the Development of Future linguistic Education for the XXI Century: The Choice of Optimal Strategies

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Abstract: The paper analyzes orientations and research tools in the field of linguistics, namely the development of linguistic education, general themes and strategies, specific scientific orientations, as well as some aspects of the institutional structure where it develops. The perspective of the topics analyzes the general strategies that have already been defined by scientific thought or are still in their developmental stage and proposes their own strategies for foreign language learning. The transition to an information society has caused a paradigm shift in the gravity and role of language knowledge in society. With the regard to educational knowledge, the paradigm change can be summarized as follows: there has been a transition from the educational model characteristic of modern pedagogy to the educational model of postmodern pedagogy, which involves mainly quality learning, through a comprehensive approach, integrating the learning content at the project level of a certain learning type to achieve the ideal of learning and universal development of a holistic person. This paradigm shift is

associated with the affirmation of the triad of the learning educational model: lifelong learning, self-education, and full use of educational opportunities. The paper emphasizes the importance of foreign language learning strategies in the aspect of foreign language learning and teaching. One summarizes that the context of strategies and concepts of foreign language learning describe the taxonomy of innovative strategies, consider the role of the teacher in learning and development of future linguistic education.

Keywords: paradigm shift, postmodern pedagogy, educational opportunities, educational strategies.

Introduction

The study and teaching of foreign languages has undergone a major transformation in the last five years, focusing more on students and learning than on teachers and teaching. Along with the new paradigm shift in future linguistic education, a major concern of linguistics and pedagogy researchers is how students process new information and the strategies they use to understand, absorb, or retain information. This paper presents the context of language learning strategies, providing different definitions and taxonomies of language learning strategies presented by global linguists. The paper also emphasizes the importance of foreign language learning strategies and the role of the teacher in strategic learning. In addition, the issues of further analysis of language learning strategies are presented.

Research Problem

Language, a complex system, is capable of performing many functions: preserving its lexical composition, grammatical forms and ensuring the processes of communication. Developing, it shows a tendency to change and improve. Language as an object of study is a product and an activity. After all, apparent immutability and continuous modifications constitute the immanent qualities of this phenomenon, that is, every language is constantly created and reproduced by each individual as well as by the whole community to which it belongs (Albury, 2020). In the linguistic paradigm, the focus is on the creation and otherwise, where the former emphasizes the dynamism of language and the latter highlights its social essence, defining its homogeneity. Research on strategies for learning to teach language on the age is actively explored (Feng et al., 2020). In particular, developments in cognitive psychology influence much of the research conducted on language learning strategies (Teng et al., 2022). In most research on foreign language learning strategies, the main problem is determining how people learn/perceive the flow of new information. The problem of this research is the classification of strategies in terms of processes that directly or indirectly contribute to foreign language learning.

Research Focus

Predict the prospects for innovative changes in the development of future linguistic education and choose optimal pedagogical strategies. Focus on cognitive, metacognitive, affective-social, and immanent strategies that each student chooses according to his or her own needs. We emphasize the functions and role of the teacher in monitoring, preparing, and working with students.

Research Aim and Research Questions

The purpose of the work is to define the term linguistic strategy or language learning strategy. The objectives of the work are to highlight the environment for solving the problems of foreign language acquisition; to describe and define the strategies of world linguists; to summarize the strategies of foreign language acquisition and to summarize world experience in the strategies we propose.

Research Methodology

As the basis of the work on the analysis of innovative changes in the development of future linguistic education, the latest linguistic methods were chosen, with the help of which it was possible to formulate and propose our own strategies for foreign language learning. Among the innovative strategies of foreign language learning are cognitive and theoretical-methodological reflection, clarifying scientific concepts, and heuristic procedures. Equally effective in this area is the evaluation of technical solutions aimed at reducing the opacity of technical data and increasing the acceptability of new concepts. In addition, research in the field of literature is able to make discursive formats that give shape to innovations related to the development of linguistic education. Research on multimodality, interactivity of oral discourse, and post-mimic-gesture elements are new, effective trends in foreign language learning. We consider the integration of an intercultural perspective to be one of the crucial, albeit diffuse, strategies for the development of linguistic education. Intercultural studies research can provide a theoretical framework for the search for cultural and environmental congruence. Written and innovative communication technologies make it possible to develop strategies in line with the oral context that language education development strategies have traditionally focused on. By exploring the changes that circulate communicatively, the intercultural perspective analyzes both the changes themselves and their channels of dissemination: the creation of radio broadcasts, the storage of folklore, etc. Ultimately, the value of collaboration with national and international research networks is well established. This is even more true in the context of resource scarcity, where a common approach allows combining the different outcomes and benefits to be gained from research.

Research Results

Definition of Language Learning Strategy

The term foreign language learning strategy has been explored by many researchers. Mohamed Hashim et al. (2022) define learning strategies as any set of operations, steps, plans, procedures used by the learner to facilitate the acquisition, storage, retrieval, and use of information. Vargas-Hernández and Vargas-González (2022) state that learning strategies are intentional behaviors and opinions used by students during instruction to better help them understand, absorb, or remember new information. Lugosi and Uribe (2022) emphasize that learning strategies are an attempt to develop linguistic and sociolinguistic competencies in the language being learned. According to other scholars, the concept of learning strategies depends on the assumption that students consciously engage in activities aimed at achieving certain goals, and that learning strategies can be seen as intentional orientations and methods of learning in a broad sense (Martins & Gresse Von Wangenheim, 2022). All students use language learning strategies consciously or unconsciously when processing new information and completing assignments in class. Foreign language classes are akin to a problem-solving environment in which students are likely to encounter new inputs and challenging tasks assigned by their instructors, students try to find the fastest or easiest way to do what needs to be done, namely, to use language learning

strategy choices are inevitable. Foreign language learning strategies have been classified by many scholars (Chen et al., 2022). However, most of these attempts to categorize foreign language learning strategies reflect more or less the same categorizations without any radical changes.

Socio-Communicative Classification of Foreign Language Learning Strategies

Having worked through a considerable amount of scholarly work in the field of strategies, we suggest strategies that directly contribute to learning and those that indirectly contribute to learning. We distinguish 5 types of strategies used by students that indirectly contribute to language learning (described in Table 1).

Table 1

Socio-Communicative Strategy for Learning a Foreign Language

The main strategies that contribute directly to the development of the language system built by the student:
1. Communication strategies
2. Social strategies
3. Intrinsic learning strategies
4. Cognitive learning strategies
5. Metacognitive learning strategies

Source: formed based on the author's analysis.

They refer to steps or operations used in learning or problem solving that require direct analysis, transformation, or synthesis of learning material, not limited to the social component of learning a foreign language. We distinguish 5 cognitive learning strategies that directly contribute to language learning: (See Table 2).

Table 2

Cognitive Learning Strategies that Directly Contribute to language Learning

Cognitive process	Output result
Clarification / Verification	Cognitive and theoretical-methodological reflection. Clarifies processes of perception, information processing, and heuristic procedures.
Guessing / Inductive inference	Assessment of the technical ability to remember, aimed at the intrinsic memory technique of increasing the acceptability of new information.
Deductive reasoning	Incorporating the literature of the language under study into the lesson format allows discursive formats.
Transit of information	Extra-linguistic format: multimodality, interactivity of oral discourse, and posturo-mimic-gesture elements optimize foreign language learning processes.

Memorization

Synthesis of these strategies allows the process of memorization.

Source: formed based on the author's analysis.

Metacognitive Learning Strategies

These strategies are used to observe, regulate, or self-study a foreign language. They include various processes such as planning, prioritizing, goal setting, and time management.

Communication Strategies

They are less directly related to learning a foreign language because they focus on the process of participating in the conversation and understanding or clarifying what the speaker wanted to do. Communication strategies are used by speakers when they encounter difficulties because their communication ends above the means of communication or when they encounter misunderstanding from a co-speaker.

Social Strategies

Social strategies are activities that students engage in that offer them opportunities to be open and put their knowledge into practice. While these strategies provide access to target speech, they contribute indirectly to learning because they do not directly lead to memorization, storage, retrieval, and use of language.

Classification of intrinsic strategies for learning a foreign language

We believe that language learning strategy are aimed at the development of communicative skills. We divide language learning strategies into two main classes, direct and indirect, divided into 4 groups.

Immanent strategies help students regulate their learning. Affective strategies deal with the emotional demands of the learner, such as confidence, while social strategies lead to increased interaction with the target speech. Cognitive strategies are mental strategies that students use to understand their learning, memory strategies are those used to store information, and compensation strategies help students overcome gaps in their knowledge to continue to communicate. The taxonomy of intrinsic strategies for learning a foreign language is illustrated below (Table 3).

Table 3

Key Features Inherent in the Use of Project Methods

Strategy type	Process
Direct strategies	Memory, creating mental connections, using images and sounds, revisiting information, using, acting.

Cognitive-compensatory strategies

Practice, strategy for receiving and sending messages, analysis, and reasoning, creating a structure for inputs and outputs of information. Guessing and overcoming limitations in speech and writing.

Indirect strategies

Metacognitive strategies focus on learning, organizing and planning one's own learning, self-assessment.

Affective-social strategies

Reducing anxiety, encouraging and supporting each other, controlling emotions, asking questions, cooperating with other students, focusing on peers.

Source: formed based on the author analysis.

Having analyzed scientific works in the field of linguistic education, we base our analysis on the broad concept of foreign language learning strategies, which goes beyond cognitive processes, including social and communicative strategies. We consider metacognitive strategies, cognitive strategies, and social- affective strategies to be the most important and basic subcategories.

It can be argued that metacognitive is the term for expressing executive function, strategies that require planning for learning, reflecting on the ongoing process of learning, monitoring its production or understanding, and evaluating learning at the end of the activity. Major metacognitive strategies include self-organization, directed attention, selective attention, time management, functional planning, self- monitoring, and self-assessment.

Cognitive strategies are more limited to specific learning tasks and involve more direct manipulation of the learning material itself. Repetition, resources, translation, grouping, outlining, deduction, recombination, visualization, auditory representation, keyword, contextualization, elaboration, transfer, inference are among the most important cognitive strategies.

As for social-affective strategies, we can say that they are related to the activities of social mediation and cooperation. Cooperation and inference questions are the main social-affective strategies. Obviously, motivated students use different affective strategies. Learning a language may be called unbearable in some cases. Properly chosen strategies can help students cope with and overcome emotional difficulties.

Discussion

Since the amount of information foreign language learners have to process is quite voluminous, students choose different foreign language learning strategies to complete the tasks and process the new information they encounter. Foreign language learning strategies are good indicators of how

students approach tasks or problems encountered in language learning. In other words, language learning strategies, while sometimes unconscious, provide educators with valuable insight into how their students assess situations, plan, and choose appropriate skills for understanding, learning, or remembering new information presented by language (Isaqjon, 2022). Students who are able to use a wide range of foreign language learning strategies can improve their language skills more effectively. Metacognitive strategies improve learning time organization, self-control, and self-assessment (Qin & Zhang, 2019). Cognitive strategies involve using prior knowledge to help solve new problems (Sethuraman & Radhakrishnan, 2020). Socially affective strategies involve asking native speakers to correct their pronunciation or asking a classmate to work together on a particular language problem (Ayedoun et al., 2019). Developing skills in the metacognitive, cognitive, and social-affective triad can help a student develop independence and autonomy with which to take responsibility for their learning (Shukla, 2019). Gross (2019) argues that foreign language learning strategies contribute to students' communication skills. As a broad concept, language learning strategies are used to refer to all foreign language learners' strategies for learning the target language, and communication strategies are a type of language learning strategies (Lestari & Wahyudin, 2020). Hence, it follows that foreign language teachers who want to develop students' communication skills and language learning need to be familiar with language learning strategies. As Poorebrahim et al., (2019) argue, language learning strategies are especially important for learning a foreign language because they are tools for active and autonomous movement, which is essential for developing communicative competence. In addition to developing students' communicative skills, teachers teaching them how to use foreign language learning strategies can help them become better students. The ability to help students understand good foreign language learning strategies and teach them how to develop and use such strategies can be considered a valuable characteristic of a good linguist and educator (Ahmadi-Azad et al., 2020). Research on innovative foreign language learning strategies has revealed a number of positive strategies, so such strategies can be used by weaker students who are trying to improve their learning. A foreign language teacher with the goal of teaching his students how to use language learning strategies should learn more about the students, their interests, motivations, and learning styles (Imanova, 2021). He or she can examine the foreign language learning strategies that students have chosen and use by observing their behavior in class (Doghonadze et al., 2020). In addition to observing their behavior in class, the instructor can prepare a brief questionnaire for students to fill out to describe their method of learning a foreign language at the beginning of the course. In addition to the students, the instructor should also analyze the selected textbook to determine if it already contains language learning strategies or teaching those strategies. Also, he should examine his own teaching methodology and determine his lesson style. By analyzing their lesson plans, the foreign language instructor can determine if students to use different learning styles and strategies (Moskvitcheva & Abdullaev, 2021).

Conclusions and Implications

Foreign language learning strategies, be they specific actions, behaviors, tactics, or techniques, make it easier to learn the target language. It is clear that all foreign language learners use their own strategies in the learning process. Considering that factors such as age, gender, personality, motivation, self-concept, life experience, learning style, enthusiasm, anxiety, etc. good foreign language learning strategies or should be trained to use and develop the same strategies to achieve success. Research on foreign language learning strategies must go beyond descriptive taxonomies and respond to a wide range of requirements such as: the context of foreign language learning strategies, the ease, and accessibility of foreign language learning strategies, the role of foreign language proficiency in using

language learning and teaching strategies, the time it takes to teach specific students certain foreign language learning strategies, evaluating and measuring the success of using foreign language learning strategies or teaching Compliance with these requirements can be expected to pave the way for building the theory that seems necessary to make more language learning strategies relevant to the current practice of innovative foreign language teaching.

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STEM Office of the Ukrainian Language of the Institution of General Secondary Education (Ukrainian Experience)

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Abstract: The implementation of the program for the creation of the STEM cabinet of the Ukrainian language allows to achieve the following mandatory learning outcomes for the following educational fields: for the linguistic and literary field of education: the ability to perceive, analyze, interpret, critically evaluate information in texts of various types, in particular informational and artistic texts, media texts, and use information to enrich one's own experience and development; to express one's own thoughts, feelings, attitudes and ideas, to interact with others in writing, in particular by interpreting informational and artistic texts; if necessary, interact with other persons in the digital space, observing the norms of the literary language. The purpose of the research is to analyze the specific features of the formation of the STEM education in Ukraine and to find out the ways the STEM office of the Ukrainian language of the institution of general secondary education. The main methods used in the work were: comparativistic, method of abstraction, deductive method, concretization. concretization. This study conducts a systematic review of analyzes of 56 articles from 2012 source papers.

The results state that in the war time in Ukraine it is very important to keep the development of the culture from generation to generation and to form the STEM office of the Ukrainian language of the institution of general secondary education. The conclusion is oriented on the improving the importance and the development of the STEM education, based on the increasing interest on the Ukrainian language.

Keywords: STEM education, Ukrainian language, secondary education institutions, competence, developed personality, innovation, critical thinking, project.

Introduction

The STEM-oriented approach to education, based on interdisciplinary principles in the construction of educational disciplines and individual didactic elements, aims to comprehensively form the key professional, social and personal competencies of young people, which determine their competitiveness in the labor market. The use of the leading principle of STEM education - integration allows for the modernization of methodological principles, content, volume of educational material of subjects of the natural and mathematical cycle, technologicalization of the learning process and the formation of educational competencies of a qualitatively new level. Today, the development of STEM education is important and a priority for Ukraine, is realized and implemented in all kinds of educations: formal, which is supported and carried out through all types of education: formal, informal, informal - based on online platforms, media products, STEM centers/laboratories, virtual STEM centers, through non-standard methodical STEM techniques: tours, quests, contests/competitions, festivals, hackathons, workshops, etc.

Research Problem

Today, at the time of reforming the education sector, holding a traditional lesson, where the teacher is the main source of knowledge, is not an incentive and motivation for education seekers. Today's graduates are competitive future innovators, patriots, and therefore should receive thorough knowledge of technical and natural sciences, language and literature. In addition, students must be able to communicate, work in a team and solve problems in the context of innovative opportunities and current societal needs. It is the use of STEM - education that makes it possible to implement these tasks.

Research Focus

STEM education is becoming for Ukraine one of the key directions for modernization of the educational sector, a component of the state policy on strengthening the economy and development of human capital, one of the main factors of sustainable innovative development. STEM education is one of the areas of anticipatory education for sustainable development, which is expected to respond to the current and future demands of Industry 4.0. It is she who must provide high-tech production with the necessary personnel. In the modern realities of the development of Ukrainian culture and language, the STEM cabinet of the Ukrainian language of a general secondary education institution is necessary for Ukrainian secondary education institutions.

Research Aim

The main purpose of the article is to reveal the essence and peculiarities of the STEM classroom of the Ukrainian language of the general secondary education institution, which makes it possible to carry out: modernization of methodological principles, content, the volume of educational material of subjects of the natural and mathematical cycle; technologization of the learning process and the formation of educational competencies of a qualitatively new level; better training of young people for successful employment and further education.

Research Questions

Today, the development of STEM education is important and a priority for Ukraine, that can be viewed in all types of education: formal, informal, and informal - based on online platforms, media products, STEM centers/laboratories, virtual STEM centers, through non-standard methodical STEM techniques: excursions, quests, contests/competitions, festivals, hackathons, workshops, etc. For the effective development of STEM education, the primary task is to develop the scientific base and special teaching aids; training and advanced training of special courses of workers in different fields of science and pedagogy; expanding the network of regional STEM centers/laboratories; creation of an information base for the development of STEM education in Ukraine using IT technologies, etc.

Research Methodology

The theoretical and methodological basis of the study became the fundamental provisions of modern economic theory, the work of leading Ukrainian and foreign scientists and practitioners in the field of STEM education formation, the role of the Ukrainian language, and the development of the Ukrainian culture. In the research process, general scientific research methods were used, namely: system analysis, synthesis, deduction and induction, typology, historical-logical, institutional analysis, and structural-functional analysis.

Research Results

Clause 10 of Article 18 of the Law of Ukraine "On Education" states that professional development is a continuous process of learning and improving the professional competencies of specialists after obtaining higher and/or postgraduate education, which enables the specialist to maintain or improve the standards of professional activity and continues throughout the entire period his professional activity (Honcharova, 2017). Currently, teachers are working in the conditions of a new model of education, the implementation of the "New Ukrainian School" concept, and the introduction of new approaches, in particular, STEM education.

Nowadays reality forces the teachers think for the future life, to be ahead of his time, which involves the improvement of hard and soft skills, constant analysis of pedagogical activity, and making corrections by social demands during the entire professional activity. Information and communication technologies radically transformed the educational space, qualitatively changed the environment, opened up new opportunities, and became the basic system-creating factor of the development of education in general and director of postgraduate pedagogical distance education. When organizing professional development courses for teaching staff, distance learning methods are increasingly used, which makes the process of acquiring knowledge and skills more accessible and effective, encourages

teachers to study throughout their lives, and is a real impetus for the development of informatization of education, and IT-oriented learning tools.

Organization of the educational process in wartime is a new challenge for the pedagogical community. Because in some regions of Ukraine there is a real threat to the life and health of civilians, it is recommended to organize the work of educational institutions depending on the specific situation, with the priority of ensuring the maximum possible safety for every child, every employee of the education system (letter of the Ministry of Education and Science of Ukraine dated 06.03.2022 No. 1/3371-22). The teacher's task is to adjust the educational process so that it is comfortable and safe for both students and himself, therefore, the optimal form of organizing the educational process in the conditions of martial law is a mixed form of education - a combination of online education, traditional and independent education (Tang et al., 2022).

Table 1 is presented the number of schools that STEM education and the number of STEM offices in the Ukrainian language of the institution of general secondary education.

Table 1

The Number of Schools that STEM Education and the Number of STEM Offices in the Ukrainian

	2010	2016	2017	2018	2019	2020	2021
STEM offices	24	423	865	1065	1634	1976	2765
STEM Ukrainian offices	14	46	67	97	139	153	174

Source: created by the author.

The Ministry of Education and Science of Ukraine has implemented several educational initiatives for teachers, students and their parents regarding distance learning, psychological support and information. In addition, several recommendations on how to organize the teaching of educational subjects in the conditions of martial law were provided by the State Service for the Quality of Education. Teachers can use the resources of the Ukrainian State Center for Out-of-School Education, and the National Ecological and Naturalistic Center for Pupils to organize remote classes in out-of-school education institutions; to listen to lectures by Nobel Prize laureates and scientists from all over the world offered by the National Center "Small Academy of Sciences of Ukraine".

The introduction of STEM education is carried out taking into account the principles: a personal approach, aimed at taking into account the age, individual characteristics of those seeking education, their interests and abilities, special educational needs; constant updating of the content of education taking into account the achievements of science, the development of technologies and the requirements of the labor market; continuity – formation of necessary competencies at all components and levels of education; patriotism and civic orientation; productive motivation of education seekers to carry out research and project activities, inventions; the essential role of mathematics in the integrative approach to the implementation of STEM education, its consistent, thorough, high-quality teaching; encouraging

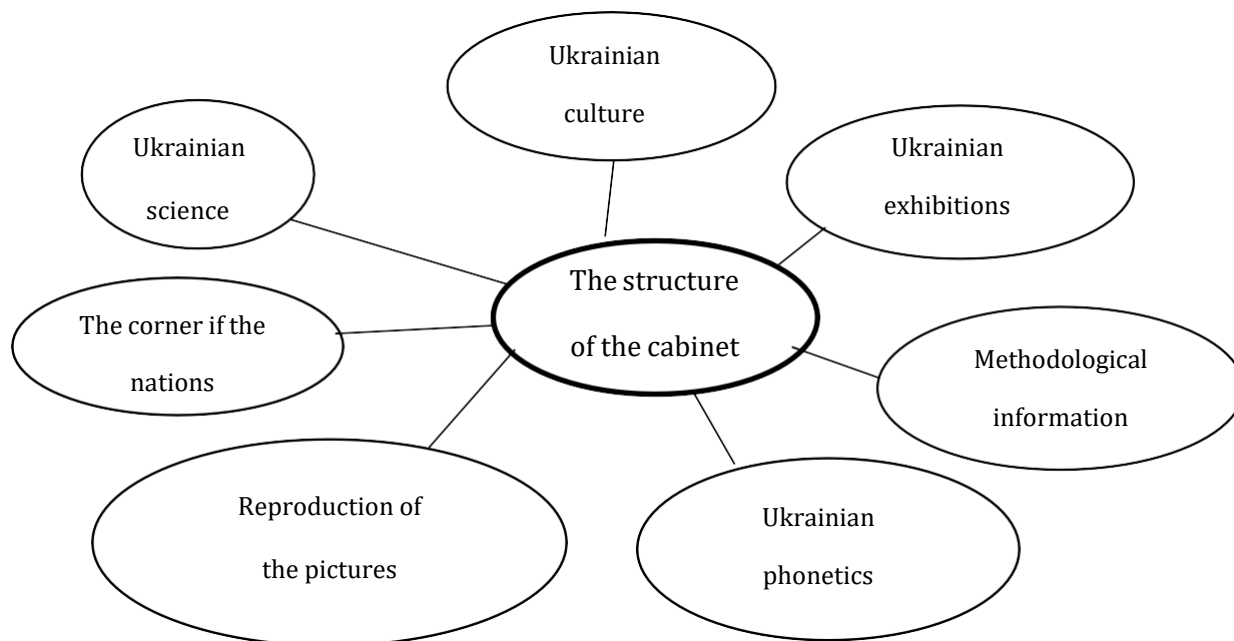
the formation and development of "flexible skills" among students (presentation skills, group work, communication); use of developmental and problem-based learning technologies; development of institutions of specialized scientific education (Korshunova et. al., 2018; Yadegaridehkordi et al., 2019).

The organization of STEM education is based on the further implementation of the "New Ukrainian School" reform, which will begin in September 2022 at the level of basic secondary education, taking into account the Action Plan for the Implementation of the Concept for the Development of Science and Mathematics Education (STEM Education) until 2027, which determines a set of activities related to the formation and development of scientific research.

To ensure scientific and methodological support for STEM education, it is important to develop integrated curricula for all types of educational institutions for teaching special, elective courses, electives, organizing the work of scientific and technical circles, robotics, engineering, natural and agricultural disciplines, modern scientific directions, the latest technologies, taking into account the best national and international experience (Patrikeeva et. al., 2018). The structure of the office needs to look the following way, as it is analyzed in figure 1.

Figure 1

The Structure of the Cabinet of the STEM Office the Ukrainian Language of the Institution of General Secondary Education



Source: created by the author.

The development of STEM education in institutions of general secondary and extracurricular education in the 2022/2023 academic year is carried out by:

- Laws of Ukraine "On Education", "On Comprehensive General Secondary Education",
- "About extracurricular education", "About scientific and scientific and technical activities",
- "About innovative activity", "About culture";
- The state standard of primary education, approved by Resolution No. 87 of the Cabinet of Ministers of Ukraine dated February 21, 2018 (Balyk et al., 2017);
- State standard of basic secondary education, approved by Resolution of the Cabinet of Ministers of Ukraine dated September 30, 2020 No. 898;
- The concept of implementation of the state policy in the field of general secondary education reform "New Ukrainian School" for the period until 2029, approved by the order of the Cabinet of Ministers of Ukraine dated December 14, 2016, No. 988-r;
- Concept of the development of science and mathematics education (STEM education), approved by the order of the Cabinet of Ministers of Ukraine dated August 5, 2020 No. 960);
- Plan of measures for the implementation of the Concept of development of science and mathematics education (STEM education) until 2027, approved by the order of the Cabinet of Ministers of Ukraine dated January 13, 2021, No. 131-r; Plan of measures for the popularization of natural sciences and mathematics until 2025, approved by the order of the Cabinet of Ministers of Ukraine dated April 14, 2021, No. 320-r;
- Regulations on the procedure for the implementation of innovative educational activities, approved by the order of the Ministry of Education and Science of Ukraine dated November 7, 2000 No. 522, registered in the Ministry of Justice of Ukraine on December 26, 2000, under No. 946/5167 (as amended by the order of the Ministry of Education and Science, Youth and Sports of Ukraine dated November 30, 2012 No. 1352);
- order of the Ministry of Education and Science of Ukraine dated 16.10.2019 No. 1303 "On approval of the Standard for specialized education in the scientific direction";
- order of the Ministry of Education and Science of Ukraine dated April 29, 2020 No. 574 "On approval of the Standard List of teaching aids and equipment for classrooms and STEM laboratories" and other legislative acts.

Discussion

The effectiveness of training depends on many components: the skill of the teacher, teaching methods, content of the program, training equipment, and means of managing the training process. Life requires the complex use of various materials to ensure a comprehensive impact on the development of a child's personality. However, the presence of an adequate material base in itself does not decide the success of the case (Zhao et al., 2021). A scientific organization of work is also needed, thanks to which it is possible to achieve high pedagogical effectiveness with the least expenditure of energy and effort. The most favorable conditions for the rational use of the entire complex of educational equipment are provided by work in school classrooms. Currently, schools have literary and language classrooms, and most often classrooms of a mixed type (linguistic and literary). In modern scientific and pedagogical

literature, the following definition of a study room is given - it is a single, organically connected system of educational equipment, mounted in a separate room, designed by the requirements of the scientific organization of the work of the teacher and student, which ensures a high level of teaching the subject (Chang et al., 2022). The main tasks of the study room are:

1. Implementation of the practical and creative components of the training content.
2. Provision of in-depth study of literature and organization of specialized training in high school.
3. Ensuring that teachers can use modern pedagogical means of learning.
4. Generalization and dissemination of the experience of the best teachers.
5. Organization of extracurricular work with students.
6. Conducting meetings of the school methodical association
7. The possibility of individual preparation of the teacher for classes and raising his scientific and methodical level.

All material resources of the language and literature office can be conditionally divided into three groups:

- educational equipment - books, educational and visual aids, audiovisual means;
- general equipment - furniture and devices that facilitate the use of educational equipment;
- special means for the scientific organization of work (Peterson, 2020).

When organizing the work of the office, language teachers must constantly involve schoolchildren in this activity. Only under these conditions will the office be able to successfully fulfill the functions of a modern school of the 21st century: - to promote the rapid, active assimilation of necessary scientific information by students; - to create optimal conditions for educational and cognitive activities of schoolchildren; 6 - to contribute to the formation of a spiritually rich personality. The office should be bright, meaningful and aesthetically decorated. As psychologists note, the correct selection of colors used to paint doors, windows, furniture, and walls is of great importance. The work of school classrooms is carried out by the Regulations approved by the order of the Ministry of Education and Culture of Ukraine dated July 20, 2004 No. 601 (Patrikeeva et al., 2018).

Among the main objects of this room should be noted:

- Equipment for quality training. This list includes books, magazines, training manuals, audio and video tools, and other elements of a technical nature;
- General referral equipment. Furniture, teacher's workplace, desks and chairs for students, various devices for working with educational equipment, etc.;
- Special tools for the scientific coordination of work.

Go to the section Stands in the office of Ukrainian language and literature

It should be noted that it is necessary to constantly involve students in the process of designing the office of Ukrainian language and literature. This is how the improved assimilation of educational material and the development of the cognitive activity of each child will take place. Today, there are a lot of stands for this cabinet, among which such shields as:

- History of Ukrainian literature;
- Ukrainian writers;
- Literary map of Ukraine;
- Quotes by famous Ukrainian writers and others.

It should be noted that the production of stands for this room should first of all be based on the quality of the material for execution and the symbolic filling of the information boards. After all, the stands are a defining part of the classroom interior and play an important role in the aesthetic and educational segment of this room.

Please provide the interpretation of obtained results and compare them with the results of previous studies. Highlight the limitations of your study. Add conclusions if the discussion section is short and simple to read.

Conclusions and Implications

The implementation of STEM education is carried out using such basic organizational forms as a lesson/class, project, quest, hackathon, and others. A STEM lesson/class involves the integration of three or more STEM disciplines (biology, physics, chemistry, geography, mathematics, and technology). The STEM project is an educational and research activity of students that involves an interdisciplinary approach and the creation of a practical product. A STEM quest is an intellectual competition that includes a set of challenging tasks with elements of a role-playing game, the implementation of which may require any resources, in particular, Internet resources. A STEM hackathon is a form of conducting an educational session/event, during which teams solve a certain thematic, or social problem in a limited period (Ledger et al., 2022). Examples of the implementation of such forms of education can be found on various educational resources or in collections of materials, for example: the best gender-sensitive STEM lessons; useful resources for conducting STEAM lessons; STEM rising (resources for conducting STEM classes); ideas for creating spectacular STEM projects; "STEM projects in elementary school"; STEM projects (a description of STEM projects from the Kolosok magazine; Mechanics in Ukrainian; STEM experiments (an online resource for teachers who want to implement STEM and are looking for new project ideas); Scientix (an online platform containing didactic materials for teachers natural and mathematical disciplines, and also informs the European educational community about innovative educational competitions - European STEM Discovery Week (STEM Discovery Week) and STEM Ahead Competition); learning strategies and resources that are designed to arouse students' interest in scientific research); Mathigon (mathematical platform containing interactive resources for interesting mathematics classes); Collection of materials "STEM- school-2021"; Collection of materials "STEM-week – 2021" ; Collection of materials "STEM Week - 2020"; STEM Library Laboratory.

The use of the above-mentioned and other innovative and interactive methods and forms of work allows to effectively implement the requirements of the Concept of the New Ukrainian School and will

contribute to the formation of critical thinking, creativity, scientific research, engineering, and invention skills in students.

Observing the rapid development of technology, it is difficult to predict what the world will be like, even shortly. Is the modern school capable? to prepare schoolchildren for mastering the specialties of the future, adaptation to quick changes? STEAM - education can be the answer and help. After signing of the Memorandum on the creation of the STEM-education Coalition on September 16, 2015 of the year in Kyiv, the issue of introducing elements of STEAM education in a modern school became relevant. Their implementation should become a priority direction in solving the problem of increasing children's interest in future specialties (Institute of Education Content Modernization, 2017).

The creative space of the child's worldview, where he fully realizes his own needs becomes one of the ways of spreading STEAM education within the framework of Nova Ukrainian school. However, it is important to understand that STEAM is not just a technical education. She covers a much broader concept, namely a successful combination of creativity and technical knowledge. The main goal of STEAM education is the development of creative thinking and skills the use of an engineering approach to solving real problems, understanding the importance of design, awareness of the role of technology in their decision. It is important to involve the teachers who have to become real in the changes agents of educational reform changes.

It is interesting that during STEAM lessons in the focus is not on the teacher, but on the practical task required solve. Students learn to solve this practical task by means of tests and mistakes, rather than studying the "dry" theoretical part. It is fair to note that we live in a not quite "linear" world, everyone every second of our lives intersects with different disciplines. During the campaign in movies, shopping, etc. The child is forced to figure out how apply certain knowledge in different life situations (Bygstad et al., 2022). Quite often this one the process takes place with errors, while STEAM education teaches from the school desk successfully combine the acquired knowledge to solve real life situations. As a result, the child enters the adult world much more prepared and not so much afraid of problems and difficulties.

It is necessary to conclude that the goal of the development of STEM education is the comprehensive spread of innovative teaching methods and the unification of the efforts of participants in the educational process and social partners in the formation of the necessary competences of education seekers, which provide an opportunity to offer solutions to the problems of society by combining natural sciences, technologies, engineering and mathematics. One of the systemic components of the formation of the content of STEM education is the transfer of knowledge, which ensures the implementation of the achievements of the scientific sphere in the educational process. The methodological basis of the formation of the content of STEM education is a transdisciplinary approach.

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Attempts of Scientific Reflection on the Role of e-Learning of the Future in the Area of Digital Transformation: New Opportunities and Experiences with DevSecOps

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Abstract. The introduction of such an important component as e-learning into the education system is an important tool for the informatization of education problem implementation and requires certain knowledge. It is also necessary to form the conditions for mastering the latest pedagogical approaches and methods that have acquired new forms or appeared under the influence of the introduction of information technologies into educational activities. The use of the latest technologies in educational activities is one of the key, as it increases the opportunities for the development of

creative potential and helps in mastering professional knowledge, which is based on the awareness of one's own educational and developmental goals. The purpose of the research is to analyze the specific features of e- learning development in the period of digital transformation and to figure out the new opportunities of DevSecOps. The main methods used in the work were: comparative method, method of abstraction, deductive method, concretization. The results states that the formation of electronic education in Belarus is connected with the opportunities provided by information and communication technologies, and falls on the first decade of the XXI century, when the understanding and implementation of this educational practice at the institutional and regulatory levels begins. Belarus is gradually joining the system of distance education, is involved in cooperation with international open universities on the introduction of e-learning, and is also forming its own educational electronic environment. The conclusion is oriented on the realization that in the time of digitalization and technological transformation, in the countries worldwide can be noted the tendency in the development of DevSecOps.

Keywords: digitalization, digital transformation, e-learning, Belarus, changes, attempts, experience, DevSecOps.

Introduction

Research Problem

The latest technologies provide new opportunities for solving the problem of informatization of education. It is these technologies that act as an "amplifier" of intelligence and open other dimensions of consciousness, connecting them into a single whole and creating a certain system of knowledge of a new level. The use of the latest technologies serves as a necessary means of achieving the level of quality education, strengthens creative possibilities and effectively affects the personal perception of the surrounding world. The multifaceted use of information technologies in education is rapidly and constantly growing. To prepare theoretically at a high level, to teach how to choose a strategy and options for acquiring knowledge, to form active and personalized learning strategies - all this will significantly increase the effectiveness of teaching and acquisition of knowledge by those who study. The relevance of the use of e- learning in the education system is due to the need to effectively and at the appropriate level ensure the implementation of the main tasks set before education, increase personal, general cultural and communicative qualities. Unfortunately, it must be stated that there are still many factors and problems inhibiting the wide introduction of information technologies in education, one of which is the incomplete awareness of the importance of these innovations by some specialists.

Research Focus

Education is a means of socialization and personality formation, a kind of catalyst that supports the balance of society from the inside. Education consists in the formation of stable value orientations in a person, based on a broad base of knowledge and confidence in one's capabilities, which are manifested in mastering the competencies necessary for life in society. The stability of society is directly dependent on the stability of its educational systems, the conformity of education itself with modernity, that is, on what we teach a growing person and to whom we offer the content of education. In our

country, information technologies have been introduced into education for almost half a century. The first steps are the use of educational computing complexes such as DVK, UKNC, Search, Yamaha, ZX Spectrum, Agat and others, mostly in computer science classes. The second important step on the way to the introduction of information technologies in education is the wide use of multimedia capabilities of computer technology. And the third step consists in the wide use of Internet resources both in the classroom and outside the classroom educational activities. Over time, the use of Internet resources is becoming increasingly popular and it is being implemented and used also during homework. It should be emphasized that the mentioned applications of information technologies in education are the first steps of informatization of education.

Research Aim and Research Questions

Informatization of education is a set of interconnected organizational-legal, socio-economic, educational-methodical, scientific-technical, production and management processes aimed at meeting information, computing and telecommunication needs (other needs related to the implementation of methods and tools information and communication technologies - ICT) of participants in the educational process, as well as those who manage and ensure this process (including its scientific and methodological support and development), and are also the basis of informatization of society, which in recent times is extremely relevant for our country UNESCO experts believe that in order to match the qualifications of workers to the level of the information society, it is necessary to introduce electronic learning into the educational process, which orients students to a new style of education and promotes the development of their abilities and skills for further learning throughout life.

Research Methodology

The theoretical and methodological basis of the study of the importance of e-learning in the period of modern digital transformation, the specific features of Belarus informative transformation, the fundamental provisions of modern theory based on new experience of DevSecOps, the work of leading Belarus and foreign scientists and practitioners in the field of digitalization, new opportunities of DevSecOps, the digitalization of the society have become very popular in the period of transformation of the post-industrial society. In the research process, general scientific research methods were used, namely: system analysis, synthesis, deduction and induction, typology, historical-logical, institutional analysis, structural-functional analysis.

Research Results

Electronic learning (e-learning) is a form of learning using a computer curriculum. It covers computer-based training, electronic enforcement systems (EPS), distance learning and online learning. The educational process in e-learning is conducted on the basis of electronic training courses. E-learning is playing an increasingly important role in the training of organizational personnel. Yes, in the USA, almost 90% of companies implemented e-learning. In Belarus, the greatest activity regarding the introduction of electronic training of employees is observed in banks and insurance companies. For example, PrivatBank introduced a distance learning system back in 2001. E-learning is most in demand where there is a need to train a large number of employees in similar competencies. It is provided through websites and intranets; CD-ROMs are also widely used. Training is possible in the form of online coaching and discussion forums. Content can be presented using PowerPoint, video and audio clips, "drag questions", PDF files, links to websites and communities of learners. E-learning contributes to the

formation of a single corporate center of knowledge. Thanks to this form of personnel training, social groups of employees are formed according to professional needs and interests, and this is one of the components of the organization's knowledge management technology, which involves searching for information, forming a knowledge base, sharing and using it (Bykov et al., 2020).

The following types of e-learning are distinguished:

- e-learning at an individual pace, when the employee uses technology, but at the same time is not connected to the teacher or other students;
- e-learning, during which an employee, using technology, interacts with a teacher who is in another place;
- e-learning thanks to the exchange of information and knowledge takes place in the form of discussion forums, practical communities, bulletin boards and chats.

The introduction of e-learning requires large funds from the organization. According to expert estimates, the implementation of an average project can cost about \$500,000. Therefore, e-learning is easier to implement for large companies than for medium and small ones. In order to reduce the costs of introducing e-learning, small enterprises can use the services of external providers that offer e-learning systems for rent, outsourcing of educational process support, etc. The cost of the project, in particular, includes the costs of setting up and adapting the product, purchasing licenses for users, and developing electronic training courses. Personnel costs are also significant, since the development of high-quality electronic courses involves the involvement of a team of professionals: programmers, artists, animators, pedagogical designers, etc. Under such conditions, for the purpose of economical use of funds, it is important for the enterprise to weigh for itself both the advantages and disadvantages of the introduction of electronic training of personnel. At the same time, e-learning should be optimally combined with other forms of employee training.

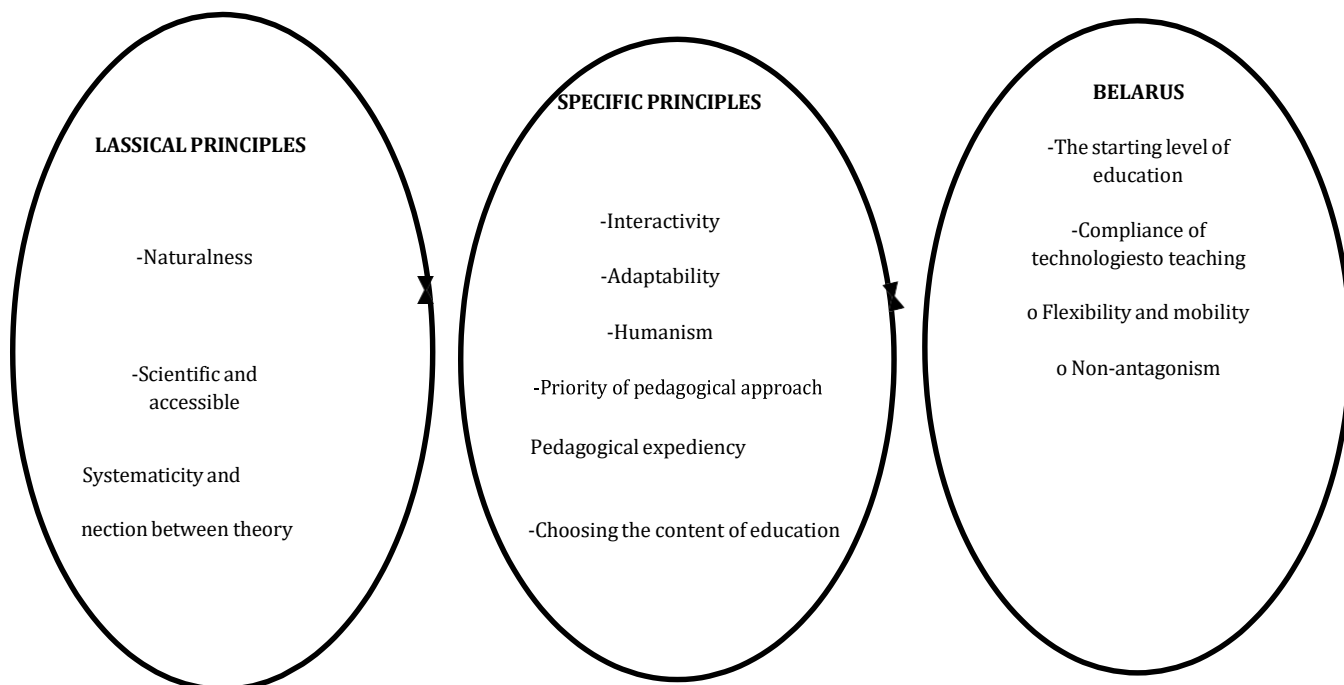
The advantages of e-training for personnel include: preservation of working hours of employees who do not leave their workplaces, while simultaneously ensuring high quality of education; reduction of the organization's expenses for teachers and trainers; the possibility of simultaneous training of a large number of employees of the company's divisions and branches located in different regions; reduction of expenses for students' and trainees' trips to educational institutions and per diems for renting residential premises; use of e-learning as an element of personnel certification in order to determine the compliance of the employee's competence level with corporate requirements; the use of interactive technologies reduces learning time by an average of 50%; work stability (a computer, unlike people, does not have bad or good days), mastery of learning (if a student does not cope with one task, he cannot move on to another) (Kremen, 2020).

Certain disadvantages of e-training of personnel include: it is difficult to form practical skills in the learning process, since there is no live contact with the teacher; it is difficult for an employee at the workplace to plan and find the necessary time for training during working hours; there is no direct communication with the same employees from other organizations (similar problems, ways to overcome them, finding optimal approaches to various tasks); the speed of implementation of achievements of scientific and technical progress is ahead of the speed of development of e-learning courses, while the teacher is a direct carrier of new knowledge and changes.

During the analyses of the classical principles, it is possible to underline the classical and specific principles of e-learning and those that are widespread in Belarus, that are presented in figure 1.

Figure 1

Classical, Specific Principles of e-Learning and Principles of e-Learning of Belarus



Source: created by authors.

Analyzing the specific features of e-learning in Belarus it is important to mention, that nowadays there are couples of types, the main of which are:

Online learning is a classic type of learning that uses an approach called face-to-face. With this approach, the teacher independently decides in each specific case whether it is necessary to combine regular (classical) training with online training. The advantage of this type of education is an individual approach to each student and the opportunity to work at an individual pace for each student.

Blended learning can be an effective option for obtaining an education. This approach combines offline (classical) learning with online learning.

Blended learning is a curriculum in which a student learns at least partially through online access to content and instructions and with some element of student control regardless of time, place, sequence of presentation, or pace. This is a combination of classical classroom learning with computer-mediated activities.

Studies show the effectiveness of such training in comparison with non-networked (non-hybrid) traditional counterparts. This may be partly due to the fact that this fast-paced learning model not only

increases the flexibility and individualization of student learning, but also allows teachers to expand their opportunities as facilitators of learning (Pinchuk, 2018).

Differences between e-learning and Internet learning in the period from 2010 to 2021 in Belarus are presented in table 1.

Table 1

Differences Between e-Learning and Internet Learning in the Period from 2010 to 2021 in Belarus

The characteristic of e-learning in 2021	The characteristic of e-learning in 2010
Distributed consolidated knowledge	Generation of new knowledge
Generation of new knowledge	Still having an e-teacher
Self-study	Isolation of the student
Creation of learning communities	Distribution through single providers/institutions
It is a result and a tool for supporting partners	Ignores student messages and previous achievements
Combines the student's message and previous achievements	It suppresses the student's creative approach
Stimulates a creative approach by increasing spontaneous and/or playful approaches to learning	Shrinks the role of teachers and learning mediators
Focuses on technology and content	Narrows the role of teachers and learning mediators)
Focuses on quality, process and educational content (context)	Replaces audiences. Integrates into organizational and social processes
Enriches and motivates those who don't know yet	Privileges those who already know

Source: created by authors.

As in the case of DevOps, team work is no less important to a DevSecOps engineer, and the ability to resolve conflicts will be very helpful in creating the most secure software applications. Thus, it can be said that from the very beginning of the life cycle of a software application, DevSecOps deals with its security, ensuring the creation of various means of protection.

Today, organizations face cybersecurity threats that are becoming increasingly diverse, complex, and sophisticated. At the same time, not every company has a department of cyber security specialists. But any modern IT company should think about the security of its products. The solution may be tools for automating security processes, in order to deploy security solutions faster and not have to maintain

a large cybersecurity department. In practice, the main reasons for the appearance of security breaches are deficiencies in the implementation of protection mechanisms, vulnerabilities in the application code, and configuration deficiencies (Ferrari, 2021). Very often, control by the information security service is carried out at the last stages of the application life cycle. Such a scenario is incompatible with modern DevOps and Agile methods, which reduce software delivery cycle times to several weeks. Specialists highlight the following in order to stimulate the main points:

1. Collective responsibility. Each employee of the company has his share of responsibility for information security, thereby realizing his contribution to ensuring this same security.

2. Cooperation and integration. Is it possible to achieve success in information security by confrontation? The question is rhetorical, so cooperation is only cooperation.

3. Pragmatics in implementation. For a pragmatic approach, such a model of digital security should be used, which will be independent of the infrastructure. Also, this model should immediately focus on the

development of software applications, ensuring security, confidentiality and trust in the digital environment.

4. Support for development standards. Sometimes it is not easy to fill the gaps between development and standards. The key to this will be the transformation of management tools into appropriate software criteria. Also, we must not forget about the turning points in the software life cycle - it is here that the above- mentioned control tools can be measured and automated.

5. Automation. How to improve software quality? With the help of regular, thorough and timely testing. It is important to automate processes that are amenable to automation, and it is desirable to abandon those that are not amenable to automation.

6. Measurement+monitoring+reporting+action. For the implementation of DevSecOps to be successful, software development must be constantly monitored by responsible persons. The main Usually, DevOps engineers (table 2) come from system administrators who are no longer interested in their profession or who are dissatisfied with the salary. Admin experience usually covers the Ops part, so you only need to cover the basic Dev part to get started. As a DevOps engineer, you are faced with a large number of different tasks that are often dissimilar. Thanks to this, this profession remains interesting even after many years (Calvani et al., 2019).

Table 2

The Advantages and Disadvantages of DevOps Engineers

Advantages of DevOps engineers	Disadvantages of DevOps engineers
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The demand for such specialists. DevOps engineers are flying like hotcakes right now. Yes, the demand has always been high, but due to the lack of qualified personnel, clients make concessions and are ready to offer attractive conditions for an engineer

Incomplete projects that only cover one or two aspects of DevOps. For example, CI (the code build and test process) and its release, where the engineer is only responsible for delivering the build results and verifying that everything was successful. Or an Infrastructure Engineer who is only involved in setting up servers and environments and does not work directly with developers or customers.

Close cooperation between teams of developers, testers and other participants in the development of a software product. This gives an opportunity to delve deeper into the project and, as a result, speed up its entry into the market.

There are often positions like a DevOps engineer, but in reality it is support of an already finished product or finishing and fixing bugs for someone. This often happens when a company has developed a product with its own engineers, and less important functionality is outsourced to countries with lower labor costs to save money.

Long-term relevance of the profession. Despite the rapid development of technologies, the principles of work cannot change radically in one or even five years. Servers and Linux are not going anywhere and will still be relevant ten years from now.

In the case of incorrect work realization, a negative factor can be obtained - the costs associated with the implementation of the system can slow down the internal work of the entire company. Not every department can clearly understand the goal set before it, which will slow down the work of the entire chain.

Knowledge of programming languages is not required. Yes, you will still have to familiarize yourself with the base, but it will come gradually. Accordingly, it makes it easier to transition from system administration or even from another profession to DevOps.

Based on the accumulated problems of software development. A key flaw was seen in the interactions between the development and operation teams, which could slow down the product development process. Then DevOps engineers began to appear, occupying a niche between managers and developers, in order to configure and automate the infrastructure for the applications that developers work on.

Source: created by authors.

In many countries all over the world, in the period of digitalization that Belarus is facing also, it is very important to mention the new opportunities and experiences with DevSecOps. Advantages of DevSecOps can be characterized as the following:

1.DevSecOps integrates applications and infrastructure security tasks into Agile and DevOps processes and tools. As with Agile tools, DevSecOps includes versatile, synergistic methods such as continuous integration and continuous delivery (hereafter CI/CD) that encourage and support frequent code reviews, version control, intelligent test automation, continuous releases with low risk level and feedback. In a DevSecOps environment, a business can benefit from such practices by saving resources

through improved operations, reduced rework, improved quality through automated testing and monitoring, and faster delivery of projects/products to the client.

2.Solves security problems as they arise, when it can be done with less time and money. This approach allows checking, auditing, scanning and testing code for security at each stage of the development cycle. Security problems are eliminated immediately after they are detected. This excludes the appearance of additional dependencies and increases the speed of correction of detected security vulnerabilities. Development speed, security, and code quality increase, while costs decrease.

3.It allows sharing the responsibility for the security of applications and infrastructure between specialists in the development, security and operation of IT systems. Closes such questions as: - who is looking for vulnerabilities; - who fixes vulnerabilities; - who verifies the correctness and completeness of the correction; - how to ensure cooperation between departments. The DevSecOps approach ensures that members of the operations and security team are involved in development from the very beginning. An important role in DevSecOps is played by the distribution of security responsibilities among product and process owners. Thus, engineers and developers become owners of processes and bear responsibility for their work.

4.Integration with CI/CD conveyors. It is possible to integrate cyber security testing into sets of automatic tests. Modern programs for the automatic search for vulnerabilities allow you to analyze the source code directly through CI/CD pipelines, such as Jenkins or TeamCity, and based on the results of the work, create tickets with the task of fixing the vulnerability. In automatic tests, you can set the necessary scanning parameters for a specific project, thus taking into account the specifics and features of each product, depending on its purpose. For example, if the application uses third-party libraries, third-party component analysis (SCA) can be enabled to detect vulnerabilities in third-party code. Automation allows you to make sure that the product has successfully passed the stage of modular security testing. In addition, it is possible to test the source code by the method of static analysis at the development stage and dynamic analysis of applications at the testing stage before deploying the final update in the working environment (Cartelli, 2020).

Discussion

In the last ten years, in the world and in Belarus in particular, there has been an intensification of the introduction of technologies and practices of electronic education. Such transformations had a number of prerequisites: the rapid development of information and communication technologies, a revolutionary increase in Internet coverage and a significant simplification of access to it, the emergence of new web communication technologies, in particular social networks and mobile applications, the distribution of open software products to provide electronic (distance) learning, its organization and control.

Such rapid development also affected the development of electronic education in Belarus higher educational institutions. In particular, the principles underlying the normative regulation of e-learning in Belarus higher education institutions were revised: in the Regulation on distance learning, adopted by the Ministry of Education of Belarus in 2019, instead of centralization and a hierarchical model of the organization of the e-education system with the separation of central and supporting regional centers, the idea was formed an open system of e-learning organization in the system of higher education of Belarus, based on the initiatives and capabilities of Belarus higher education institutions, provided that

the specified criteria are met. In view of this, in 2019 the Ministry of Education of Belarus approves the requirements for universities and institutions of postgraduate education, scientific, educational and scientific institutions that provide educational services in the distance form of training for the training and advanced training of specialists in accredited areas and specialties (Malytska, 2020).

Analyzing the e-learning of the future in the era of the digital transformation in Belarus, it is necessary to mention the following specific features:

1) the availability and content of the educational content presented on the website (schedule of classes; work programs of disciplines; lecture material (electronic texts, graphics, drawings, tables, tests for all types of knowledge level control, current and final control); practical tasks with methodical recommendations for their implementation; video and audio recordings of lectures, seminars and practical works; glossary of educational material terms; bibliography; laboratory works with methodical recommendations for their implementation, etc.);

2) the use of remote interaction technologies in the educational process (for example, the systematic use of e-mail addresses or teacher accounts in social networks, separate distance education platforms (for example, Moodle), the presence of servers with a 24-hour access mode for creating, storing

and transferring data necessary for remote training and management of the educational process, software for authorized access of distance learning subjects to these web resources, etc.);

3) use of information storage servers (availability of special resources and platforms for systematic content collection: electronic card libraries, repositories, electronic catalogs, electronic servers of periodicals, educational and informational portals, etc.);

4) the application of educational platforms of electronic education (fragmentary - distance platforms by higher educational institutions in the role of auxiliary servers accompanying full-time and correspondence forms of education; systemic - distance platforms in the role of an autonomous electronic educational space for the organization of the distance learning process);

5) coverage and inclusion of the educational process in the Internet environment (the educational process is fully integrated in the Internet environment - all necessary courses are available in the electronic version, educational materials provided for by curricula and programs, all faculties and structural units engaged in professional training are presented and the organization of the educational process or the fragmented inclusion of the educational process in the web environment - only individual courses, educational and methodological materials, directions of training or structural divisions, in particular, institutes and centers of postgraduate education and advanced training are presented);

6) regulation and institutionalization of the educational process in the web environment (the presence of a separate Regulation on distance learning in the educational institution, approved by the Academic Council or a section in the Regulation on the organization of the educational process, the functioning of a division (institute, center, department) of distance (electronic) learning with the corresponding personnel and logistical support that organizationally and technologically supports distance education, the availability of methodological recommendations for the development and use of distance education technologies in the educational process, etc.).

Conclusions and Implications

In the last ten years, in the world and in Belarus in particular, there has been an intensification of the introduction of technologies and practices of electronic education. Such transformations had a number of prerequisites: the rapid development of information and communication technologies, a revolutionary increase in Internet coverage and a significant simplification of access to it, the emergence of new web communication technologies, in particular social networks and mobile applications, the distribution of open software products to provide electronic (distance) learning, its organization and control (OECD, 2020).

Such rapid development also affected the development of electronic education in Belarus higher educational institutions. In particular, the principles underlying the normative regulation of e-learning in Belarus higher education institutions were revised: in the Regulation on distance learning, adopted by the Ministry of Education of Belarus in 2019, instead of centralization and a hierarchical model of the organization of the e-education system with the separation of central and supporting regional centers, the idea was formed of an open system of e-learning organization in the system of higher education of Belarus, based on the initiatives and capabilities of Belarus higher education institutions, provided that the specified criteria are met. In view of this, in 2019 the Ministry of Education of Belarus approves the requirements for universities and institutions of postgraduate education, scientific, educational and scientific institutions that provide educational services in the distance form of training for the training and advanced training of specialists in accredited areas and specialties. The advantages of training conducted using e-learning technologies include:

1. Personification. The listener of training conducted using electronic learning technologies can independently: determine the speed of studying the educational material; determine when he wants to study; determine exactly which sections of the educational material and in what sequence it needs to be studied.

2. The possibility of training without separation from production.

3. The possibility of combining educational content to form various educational programs adapted to a specific student.

4. An opportunity to obtain much more information necessary for the assessment of knowledge, skills and abilities obtained as a result of the training. Including: time spent on questions, number of attempts, questions or tasks that caused the most difficulties, etc. The availability of such information allows for much more flexible management of training.

5. Cost. Despite the need for high initial investments, training conducted using e-learning technologies turns out to be significantly cheaper compared to traditional face-to-face training.

6. Use of a wide range of different teaching aids. All these funds can be used during traditional face-to-face training, but most often this does not happen, and electronic training requires their mandatory use. As a result of this training, which is conducted using electronic learning technologies, it is often more effective compared to traditional face-to-face training.

7. The possibility of its use for the training of persons with limited capabilities.

8. Providing access to quality education to persons who, for one reason or another, do not have the opportunity to study in traditional face-to-face form. For example, there is no high-quality educational institution in their place of residence.

9. Construction of an effective training management system based on the ability to collect much more information about the student's training compared to traditional face-to-face training.

Disadvantages of training conducted using e-learning technologies include:

1. The difficulty of making operational changes, if training has already begun.

2. The need to form additional motivation among students of training conducted using electronic learning technologies, compared to other forms of training.

3. The need for high investments when building an e-learning environment.

4. High dependence on technical infrastructure. A failure in the infrastructure can lead to a decrease in efficiency or a complete disruption of training.

5. Lack of a sufficient number of specialists in the field of electronic learning technologies.

6. High investment in making changes to educational content.

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On the Role of Digitalization and Globalization for the Development of Mobile Video Games in the Education of the Future: Trends, Models, Cases

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Abstract: The global world processes of digitalization have influenced the development of educational services and products market. To provide qualified education modern educational institutions need to use effective tools for organizing, managing, and facilitating the educational process with the help of mobile video games. The article aims to analyze the modern processes of education digitalization and the role and prospects of mobile video games in the education. The implementation of mobile applications in the educational process can provide a competitive advantage for higher education, as well as enhance the quality of individual student learning, and be useful for teachers and educators who intend to improve the methodology of the educational process. The results of the study show the growing of the market for mobile video games in education, the increase of investment and

the formation of market leaders over the past 5 years. Based on the research methodology, the specifics of mobile video games use in today's global space were conducted, and the involvement of information giants such as Google, Amazon, and other companies actively involved in the digitalization of education was investigated. It is determined that modern models of the educational process should be integrated with digital ones, actually forming a mixed model, between traditional and digital, which can improve the professional students' qualification. The conclusions and suggestions indicate that the key areas of mobile video games in education will be the creation of applications for mastering technical specialties, the demand for which is rapidly growing in the world. The practical part of the article consists in the analysis of the mobile video games development prospects and the characteristics of their key advantages and main trends in the educational market.

Keywords: mobile video games, education, educational institutions, digitalization, digital technology, information society, mobile applications.

Introduction

The modern trend of digitalization, which determines the wide penetration of digital technology in all spheres of human life, education is no exception. Mobile video games, as a tool of the educational process, is an important factor in the development of professional skills of students and pupils, because it is through the use of mobile games, increases motivation, interest and contributes to the cognitive skills of the student. In addition, mobile video games are in high demand, because almost every student owns a smartphone, reinforcing the role of information companies in the market of educational services. Mobile video games can also be useful for the teacher, as they can be used to conduct interactive lessons, contribute to the development of emotional intelligence, to improve the analysis skills of the student, to introduce relevant methods of development of digital skills of the student. In today's digitization environment, the use of video games is spreading rapidly to the European, American, and Chinese continents. Current trends are the use of highly specialized courses in mobile game platforms that can teach real-world knowledge applied to professional activities.

Research Problem

The problematic of the study is the qualitative use of modern digital technologies in education, which can increase motivation, interest, and independent involvement of the student in educational activities. Mobile video games are highly popular among young people, which creates the need for research on their use in the educational process. Modern scientists are debating about the models of organizing the educational process with the help of mobile video games. Thus, according to Atwood-Blaine and Huffman (2017), the use of mobile video games can improve the development of emotional intelligence, communication skills of the student, even in a global lockdown. The importance of introducing mobile video games in learning, according to Chen et al. (2016), shapes not only the quality of the educational process, but also shapes the student's digital skills, which is a competitive advantage in the global digitization processes, both in the education market and in the international labor market. Researchers Panagiotis and Krystalli (2020) note that the use of mobile video games will be a key tool for student involvement in the learning process, because they improve the quality of perception of the material, allow the systematic repetition of the studied material, facilitate the organization of learning activities for the teacher. Contradictory is the view of Razali (2020), who believes that the use of mobile

games should be clearly defined by the university curriculum and have a mixed form of learning between traditional and digital because it is through a mixed model that students can master the discipline. There is a debate among foreign scholars (Wichadee & Pattanapichet, 2018) on how best to use mobile video games, it is believed that the implementation of mobile video games should be designed individually for each educational institution because the use of mobile platforms in free access can inhibit the process. Therefore, scholars believe that mobile video games should also have a clear means of control coupled with traditional means of assessment, testing, quizzes, etc. Scholars Sari et al. (2022) believe that important for mobile video games is a unified assessment system that would operate on the Bologna system or use the student's own indicators of success, which can create a unified international assessment system in the use of video games. However, this issue has not yet been sufficiently investigated in the modern academic community. Prospects for further development could be the development of rating, teaching materials, and modeling the most useful mobile video games according to the needs of educational institutions.

Research Focus

In order to determine the peculiarities of the development of mobile video games in the areas of education of the future, it is proposed to study the development of the international EdTech market, as well as the popularization of the most popular mobile video games, which are highly popular among students. The results of the study can be useful for universities wishing to create their own mobile video games, which will be used by students to fulfill the individual curriculum, as well as implemented in a modern educational system. The problematic of the research concerns the possible benefits of using mobile video games, given the global trend of digitalization and the integration of digital technology in all areas of human activity.

Research Aim and Research Questions

The key research question is the formation of the problems of using digital video games in education and whether they can really improve the quality level of mastering educational material by students who use such applications. The article aims to analyze the prospects of development of the educational market of mobile video games, which in the context of global geopolitical challenges, in particular through the spread of the pandemic coronavirus, and increased international migration processes, creates a demand for quality and affordable education, which can be implemented through the use of mobile applications in the form of video games. The current problematic is the ambiguity of the use of mobile video games in education, so it is important to investigate the availability of really useful platforms that can improve students' knowledge and contribute to the organization of learning activities.

Research Methodology

The methodology of the research consists in the use of scientific research methods, in particular, through the search method - to assess the market for mobile video games, which can be used in educational activities; the analytical method - based on its use the features of the modern development of mobile video games in education were characterized, as well as features of EdTech development in the modern world. To determine the benefits of using mobile video games graphical methods were used, which allowed to distribute the benefits according to the individual characteristics of students, the

quality of the educational process organization, global trends in digitalization, as well as the introduction of creativity, as factors in the development of attention to mobile video games.

Sample / Participants / Group

The article proposes to use the materials of digital platforms - AppStore, as well as the materials of analytical reports of information companies Google, Facebook, and Amazon. Based on the analysis of the strategic policy of Google, the prospective goals of using mobile games in their own system of educational training of future employees are characterized. The obtained results allow comparing the obtained results and using the method of comparison and generalization to determine the key foundations for the development of mobile video games in the field of education.

Data Analysis

To conduct the analysis, modern reports of information companies are used, as well as research by the analytical center PitchBook, which offers a number of materials of a statistical nature concerning the circulation of venture capital, agreements in the digital technology market. In addition, based on available information, the prospects of mobile video games in the field of learning are analyzed, which based on statistical data allows you to identify key trends and predict future prospects for their development.

Using the materials of leading information companies, as well as open research of the ESU community, it is proposed to investigate the main problematic aspects of students' educational activities, as well as the level of development after the use of mobile video games in their educational activities. The proposed methodologies make it possible to determine the key foundations of the mobile video games market, as well as to determine the prospects of their use in the context of the global digitalization of education.

Research Results

As of today, mobile video games used in education are gaining popularity because of their effectiveness. In addition, the market for mobile video games is constantly growing due to the increasing digital culture in the world. A key catalyst for the development of the video game market has been the spread of the coronavirus pandemic, which has forced most educational institutions to switch to distance education, which can improve the educational process. However, because of distance work, the level of knowledge, according to ESU (European Students' Union) studies, has dropped significantly, so to improve the organization, management and management of the educational process, we need to introduce digital technologies that will be interesting not only in terms of quality of learning but also have a specific motivation for students and learners (Furio et al., 2015). That is why, in the last 5 years, the level of education is widely transformed to digital, because through the use of digital technology it is possible to improve not only the quality of teaching but also to help motivate the students themselves to learn. According to recent studies, the key factors in the development of distance learning have been the emergence of mobile video games, which is due to the high demand for the use of mobile smartphones and gadgets. As of 2021 and 2022, the use of smartphones far exceeds the use of personal computers. The widespread demand for mobile smartphones, as well as the availability of a mobile app to almost anyone, creates the need for the proliferation of an innovative EdTech marketplace. The current cases of this market are the rapid digitalization of any educational process, which can enhance

not only the quality of learning but also offer truly effective courses and disciplines that stimulate educational development.

In addition, the prospects until 2030 are the result of increased investment in the mobile video game industry in the field of education. Every year, investors are looking for the most attractive investment projects in the field of EdTech, as well as mobile video games means, because the market is not saturated enough. Let's take a look at the specifics of investment in the development of mobile educational video games, over the last 5 years in Table 1.

Table 1

Investment in the Development of Mobile Educational Video Games, \$ billion

Year/sphere	2017	2018	2019	2020	2021
Educational mobile video games	8,2	8,6	9,5	13	16
Educational video game startups	2,4	3,5	5,1	5,6	7,2
Grant programs	4,5	4,8	5,3	5,5	6,1

Source: Pitchbook (<https://pitchbook.com/>)

The results of Table 1, show that investment in the market of educational mobile games is constantly growing, which not only needs constant development, creative ideas but also has high prospects for the use of mobile games not only in private institutions but to become a mass phenomenon, as an additional tool to improve the student's own knowledge. During 2019-2021, there has been a significant increase in investment in video game development and startups in education, due to the spread of the coronavirus pandemic. During 2019 and 2020 alone, the investment portion increased by nearly 55%, and in 2021 by 30%, and in 2022 and 2023, about \$19-20 billion in educational video game development is projected. Such trends are driving the widespread use of mobile apps in education. Besides, they can be useful not only for students or applicants of new specialties but also useful for teachers, as it is teachers who try to organize classroom work more effectively. In addition, mobile apps are a quality repository for material that can be used in the learning process, because with the available material, it can be systematized, corrected, and provide partial access for students.

Mobile apps for teachers are the prerogative of most technology companies involved in mobile video game development. Thus, according to PitchBook (<https://pitchbook.com/>), there is a priority for improving linguistic and technical majors in today's world. In addition, mobile applications such as Coursera allow you to learn applied technical sciences, in particular programming languages - Python, Javascript, Java, etc. The problematics of technical specialties and programming is becoming increasingly popular in the world, as there is a significant shortage of personnel in the market, stimulating companies to develop special game applications for children, students who want to master technical specialties.

The majority of such mobile video games have real tasks on business processes, and also use game forms of learning, which can improve the quality of memorization of children in accordance with the chosen subject. It is with the quality development of distance education, as well as the wide availability of mobile applications in today's world, that the role of globalization processes is increasing, responsible for the possibility of learning anywhere in the world, as well as getting practical skills in a specialty without having to study in a special institution at university.

For example, Google in 2022 plans to create the following means of developing educational programs:

1. Creating technical courses through digital platforms and mobile applications that require only 1-2 years of study, rather than the 4-5 years that most universities in the country do;

2. The use of practical cases in education, as well as the dissemination of game activities in the educational process, fixing the mentor;

3. Implementation of a digital assessment system and automated selection and evaluation of results based on the use of cloud services and technologies.

This approach challenges the traditional way of the educational process, which cannot compete with educational technology in today's geopolitical challenges. Therefore, most universities, as well as private educational institutions, are adopting digital technologies and mobile applications to strengthen their own advantages in the market, which can not only contribute to effective student learning but also improve the quality of education in general.

The current market for video games in education has only formed in the last 10 years, Table 2., presents the top 10 video games used to improve the educational process.

Table 2

Features of the Most Popular Mobile Video Games in Education

Educational mobile video game	Feature	Features of implementation in education
DuoLingo	The mobile video game used for learning foreign languages contains a wide range of foreign languages to learn for any user: from level A to level C. This game is often used both for personal purposes and in educational institutions of universities or private educational institutions.	In modern education, DuoLingo is proposed to be used in parallel with the educational program to improve the linguistic skills of the student.
Ribbon Hero	A game that helps to improve skills in using Microsoft Office systems, as well as improves personal skills in using Windows	This game is implemented for students in schools and universities who want to improve their skills in using Excel, Access, and other Microsoft products

ClassDogo	A video game designed for teachers, which provides an opportunity to organize the learning process and classroom work online.	It is used mainly in American universities, as well as in a number of distance education institutions in Europe
GoalBook	This video game is actually a plan of the individual task of the student, which fixes his goals, learning outcomes, implemented in a game form. The key advantages are qualitative systematization of training	The video game is implemented mainly for students and schoolchildren who want to form their own learning goals and get statistical results.
The World Peace Game	The video game aims to develop knowledge of geography, political science, conflict studies, and history. Examines the characteristics of international diplomatic relations.	Introduced mainly as a tool to improve one's own self-education, and also used in the research activities of students in political science.
Coursera	The most famous mobile application among the courses of study of the applied discipline, containing levels, ranks, etc.	Used predominantly in technical courses, but a wide range of courses are available.
Mr. Pai's Class	Educational game used to organize the educational process in the classroom	A video game individually designed for educators and teachers wishing to improve the quality of communication in the classroom and educational process.
CourseHero	The mobile application, which contains special educational courses, and a number of materials that	Used in higher education institutions in America and Europe as an
	can improve the quality of learning, in addition, there is the possibility to realize communication with the teacher.	additional source of educational materials for the needs of students and learners.
Brainscape	A mobile video game that allows you to memorize the material and is also used to strengthen cognitive skills. The material is presented in the form of cards with a time limit, and then you have to reproduce the depicted material.	The video game is used for students who want to improve their memory skills as well as refresh their knowledge of a particular discipline.
Socrative 101	Mobile video game created as a partial model of student-teacher communication in a welcoming way, and also provides a number of functional properties - own digital rooms, game tests, etc.	The game has gained popularity in private educational institutions in China and Europe, which is used to improve the organization of the educational process.

Source: composed by the authors.

Video games are widely used mainly in private educational institutions and individually by students and faculty. However, the prospects of such video games can already be integrated into almost all institutions of higher education in the world by 2027, as they prefer to improve not only the quality of the educational organization but also to help motivate the student to learn, as well as to develop their technical skills. The ability to use digital technology is also important in today's world. Therefore, students from the American, Chinese and European continents are already invited to become familiar with the most popular operating systems such as Ubuntu, Linux, Windows, and their products (Li, 2021). The importance of being able to use the products of these companies can improve not only the quality of the educational process but also the development of the student's digital skills, which, regardless of the chosen specialty will have a key advantage in the labor market in the future. An important trend in the development of video games in education is the use of special means of teaching technical and communication skills.

The main benefits that can improve student learning are the following when using video games:

1. Continuous process of educational activities, because as a rule, every student uses a smartphone every day;

2. Systematization of knowledge and curriculum, most games have a structured learning plan;

3. Motivation in learning, by means of game activities, because it is the interest of students to use innovative means of learning and interesting, which is due to the age of young people;

4. Enhancement of cognitive development of the student by means of game activities. It is scientifically proven in pedagogy that the means of creative game activities activate the brain, improve memory and form practical skills of a person. Therefore, the use of video games from a physiological point of view will have a number of advantages;

5. The possibility of distance learning, access to educational materials, as well as the low cost of obtaining them. Generally, video games are much cheaper than paper-bound materials or digital articles. Most video games offer a syllabus and the ability to use an app from \$5 to \$20 per month.

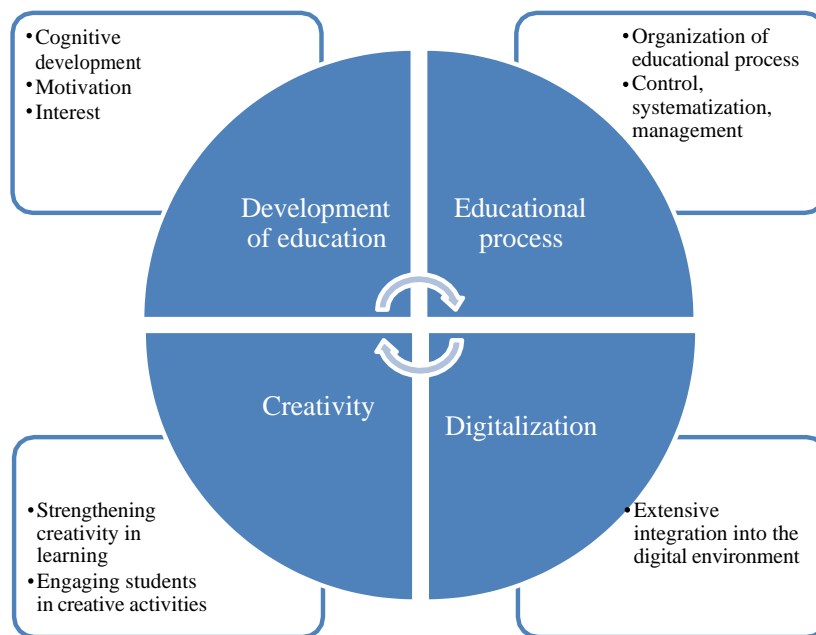
The above advantages of using video games in the education of the future may provide an opportunity to form the following scheme of benefits and organization of training by sector, as depicted in Figure 1.

World processes of globalization stimulate the search for effective solutions to the use of video games as one of the key means of the educational process since their implementation can qualitatively improve not only the applied professional training of students but also improve teaching methodologies in accordance with current trends. Prospects for the development of mobile video games are also due to the fact that most information companies create their own educational preparatory courses, which are much cheaper than training in higher education institutions and have much better training than most universities. Such factors are due to the low level of theoretical material, as well as its wide practical application, which can help students settle in after taking special profile courses. The use of video games and digital technologies provide a competitive advantage for those universities that use these technologies to develop their own educational process because it is based on it form the skills of

the student and improve the level of interest in the educational process. The problem of the spread of the coronavirus pandemic stimulates the development of distance education, increasingly reducing the real need for the physical presence of the student at the educational institution. In addition, digital education has many more advantages than traditional education, which is due solely to efficiency. Digital technology is a tool to develop the skills of students and learners.

Figure 1

Areas and Benefits of Mobile Video Games in Education



Source: authors development.

The results of the study indicate that the main models of the modern educational process are the use of digital technology tools, as well as the introduction of video games as a key activity for students and students in accordance with their need for skills. An important factor in the organization of learning is the use of a mixed model, which involves the use of digital technology, as well as physical attendance at the university or private educational institution. Nevertheless, with the problem of accessibility of learning in India, Africa, as well as a share of the Asian continent, the demand for digital technology and low-cost tools for education is constantly growing, so it is predicted that in the near future, namely by 2027, according to UN estimates, digital technology education in mobile video games will be the main trend of the 21st century.

Leading technological companies of the world, in particular, such companies as Google, Amazon, Facebook, and Apple widely implement educational startups, develop their own programs for specialists, and create mobile applications that can be used both in the educational process and in internal business processes. However, the key goal is to gain a competitive advantage in the education market specifically through the use of mobile video games.

Thus, we can conclude that today's education market is transforming rapidly to digital, increasingly using digital learning platforms and digital education tools in the form of mobile applications, which provide an educational institution with a competitive advantage in the education market, and students and teachers with the opportunity to improve the organization and management of the educational process. The prospect of mobile video games in education will be aimed at mastering technical specialties, in particular programming languages, engineering specialties, as well as the development of creative, creative abilities of the student.

Discussion

The importance of using mobile video games will serve to ensure competitiveness for universities, private educational institutions, as well as to influence the quality of mastering technical specialties. Modern digital technologies determine the integration of educational processes into digital, such a trend to transform traditional means of education into information is due not only to the spread of the pandemic coronavirus, but also the strengthening of the globalization processes of information society formation, geopolitical challenges - the war in Ukraine, staff hunger between the Chinese and American scientific space. and the need to find modern innovative solutions to solve technological, environmental, and industrial problems. For this purpose it is necessary to use the most relevant means of education, forming applied skills of students, one of the powerful such tools are mobile video games.

Prospects for further research may be the study of the use of mobile video games in the context of skills development in the field of Big Data, cloud technologies, improvement of programming skills in low-level languages, as well as dynamic because they will serve as a catalyst for the development of information society and every year, the lack of personnel in this area is only increasing. Therefore, for quality training of such personnel, research should be conducted on what technologies could be applied in mobile applications to improve the skills of students. Conduct a regression analysis of the available platforms and the performance of the students who used their materials in the training process.

A major trend of globalization is the development of video games aimed at independent mastery of certain subject disciplines - linguistic, marketing, technical, engineering, and even creative. To identify the quality of such influence, an important area that can confirm the quality of mobile video game implementation is the promptness of mastery of learning material compared to students who do not use such technology in their learning process. To this end, the use of a correlation analysis from the onset of mobile video game use in learning to employability, which can be done through empirical research through a survey, would be a positive study.

In general, the issue of using mobile video games in education should be a research priority for representatives of educational institutions, because the success and vitality of universities depends on it. Due to the high competition in the market of educational services, digital platforms, cloud services for learning, highly specialized courses, and mobile video games are the key competitors of the traditional educational institution, which should be transformed into the conditions of the modern digital environment.

Conclusions and Implications

Thus, the study shows that in today's market of educational services and products more and more digital platforms for learning are required. Investments in the development of mobile video games and

EdTech startups are growing rapidly, which in the long term by 2030 may become one of the key means of education. Among the significant advantages of using mobile video games is the possibility of optimizing the organizational activities of the teacher and teachers, as well as strengthening the discipline of students in the study of a particular discipline. The peculiarity of the introduction of mobile video games is widely used by leading information companies, such as Google, Facebook, Apple, Amazon, and a number of others. European and American universities use a mixed model of learning, which implies a combination of digital technologies in the form of mobile video games with the traditional concept of the educational process. The main challenge in the modern market of mobile video games in education is the development of effective applications for mastering technical specialties, in particular the study of programming languages, the demand for which is constantly growing in the world and there is a shortage of personnel in this segment.

Analysis of today's popular video games in education shows that the key areas of their development are linguistics, the organization of the learning process, access to learning materials, as well as the automation of curricula and goals, which allows the student to monitor the quality of their learning process. An important factor in the development of video games is the strengthening of companies like Google in developing their own learning programs, which by 2027 could be a global challenge for educational institutions focused on traditional means of teaching. Therefore, when organizing training, modern private institutions and universities to use digital platforms, and fully integrate the learning process into the digital.

The results of the study show that the market for mobile video games is constantly evolving and undergoing its changes, the key benefits in their use are the improvement of students' attention, the development of cognitive abilities, the ability to use digital products, as well as the enhancement of creativity. With such positions, the use of video games in today's globalized processes of digitalization is a priority for the educational market.

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Theoretical and Methodological Aspects of the Use of Digital Educational Technologies in the Process of Musical-Instrumental Training of Applicants for the Higher Education of the Future

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Abstract: Educational transformations caused by the global pandemic COVID-19 have actualized the use of digital technologies, in particular, in higher music education. The main purpose of the article is to analyze the theoretical and methodological digital educational technologies use aspects in the process of music-instrumental training of applicants for the higher music education of the future. General scientific methods (analysis, synthesis, deduction, and induction) and specifically scientific methods (prediction and concretization) were used in the research. The results reflect the importance of acquiring the necessary competencies in digital teaching methods work. The need for digital competence, communication skills, creativity, cybersecurity, and programming has been justified. The potential of digital technologies in higher music education was also analyzed. Namely, it is proved that the use of digital programs in music and instrumental training of students will expand the audience and lead to the possible collective writing of melodies and entire compositions in the future. To conclude, it is noted that the advantages of using digital technology in music and instrumental training are interactivity, integrality, didactic potential, comfortable learning environment, and creativity. At the same time, a broader study will require methods of teaching in higher music education of the future.

Keywords: higher music education, digital technologies, competencies, transformation, perspectives.

Introduction

Modern transformations of educational processes have accelerated greatly due to the impact of the COVID-19 pandemic. Quarantine restrictions actualized the use of distance learning forms, which before 2019 were perceived among teachers and students as an auxiliary way to master and consolidate knowledge, intended primarily for non-formal education. At the same time, the appeal to new forms and methods of teaching has demonstrated the effectiveness of distance learning, which has been achieved primarily through the active use of digital technology. In general, the penetration of digitalization into modern information society deserves further reflection given the causes, consequences, and prospects of this process. At the same time, digitalization has also subjected every single field of social activity, including the music and instrumental training of higher education applicants (Camlin & Lisboa, 2021). Consequently, many contemporary scholars recognize the importance of digital change in the training

of future professionals (Anggraini & Handayani, 2022). At the same time, Daubney and Fautley (2020), in analyzing the major transformations of music education in the Covid-19 pandemic era, noted the importance of using distance digital technologies. Park (2021), while assessing the advantages and disadvantages of online education, still believes that the digitalization of education is inevitable and requires careful consideration. Wan (2022) highlighted the importance of digital technology in music education. At the same time, Kachur et al. (2021) described the features of the formation of digital art space in the context of the professional formation of future music teachers. Cayari (2017) explored the possibilities of YouTube in the professional education system of music professionals. Pećanac et al. (2016) described key aspects of the use of digital media in higher music education. On the other hand, Tytova and Mereniuk (2022) investigated the importance of digital literacy in the system of becoming the future. In spite of this, the question of the precise acquisition of digital competencies necessary for successful music and instrumental education remains understudied. This issue is also quite relevant because it allows us to determine how specific areas of pedagogy and higher education have adapted to the current conditions in which the use of digital teaching methods achieves the highest effectiveness.

Research Problem

Important vectors for further research are digital innovations in the scientific sphere and the latest technologies, methodological foundations for use in the field of university education. Given the changes in the basic techniques and trends in the educational process, there is a need for further updates of empirical indicators and theoretical insights into the course of this process. For this reason, further involvement of optimal practices in the sphere of higher music-instrumental education will require long-term study and additional updating, taking into account the establishment of prospects for further work.

Research Focus

The article analyzes the problems of improving the theoretical and methodological foundations of higher music education institutions. especially noted the importance of the competent use of modern digital technologies and teaching methods in a rather specific industry. Particular attention is also paid to the prospects of further use of digitalization in higher music education, considered certain hypothetical problems that may arise in the introduction of technological innovations and software in the educational process, the use of best practices of other countries. Addressing these issues will potentially improve the ways of teaching, improve opportunities for further implementation of the most effective innovations in the educational process.

Research Aim and Research Questions

The main purpose of the article is to analyze the theoretical and methodological aspects of the use of digital educational technologies in the process of music-instrumental training of applicants for the higher music education of the future. When analyzing this broad problematic, attention was also drawn to several important problems associated with acquiring the necessary competencies during music-instrumental training, the peculiarities of the use of digital technologies. The received results will allow to improve the organization of the educational process, to harmonize them with modern requirements of preparation of highly skilled experts.

Research Methodology

General background

The methodological basis of this research are pedagogical methods of theoretical knowledge: specification, prediction, abstraction, etc. General scientific methods of use in the implementation of the main purpose of the study: analysis, synthesis.

Instrument and Procedures

With the help of content analysis, a review of literary sources was carried out, and little- studied problems were characterized. At the same time, based on the analysis, the main object of the study is divided into smaller topics: analysis of the necessary skills to work with digital environments, the possibility of using modern digital platforms, the prospects that digitalization reveals before higher medical education. Based on the synthesis defined subtopics are combined and defined their own judgments on the effectiveness of the use of digital technologies in the process of training specialists of music and instrumental areas. The work used the method of abstraction, based on which the transition from the analysis of general theoretical theses to the formation of specific hypotheses and conclusions was carried out. As a result of the use of the predictive method reflected the main prospects for the use of digital technology in higher music education.

The study took place in several stages, in particular on the first - the little-researched questions of the topic, characterized the relevance of the research, on the second - the characteristic of digital technologies in the system of training specialists musical-instrumental direction, highlighted the main digital technologies that are used in higher music education, on the third stage - conclusions and identified prospects for further research.

Research Results

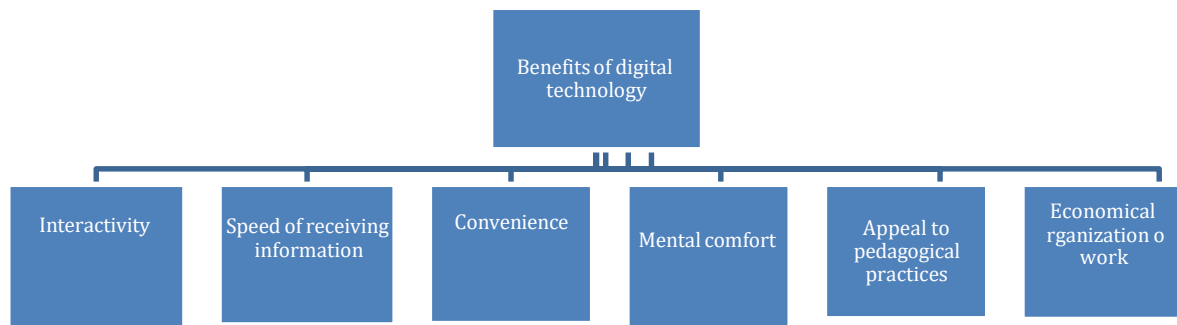
Digitalization of Music and Instrumental Education of Students: The Competence Aspect

The current development of the system of university training of future specialists of musical-instrumental art is characterized by fundamental transformations, the main content of which is the transformation of the attitude to the usual, traditional visions of the content, methods and forms of education of professional competence (Daubney & Fautley, 2020). Specialists note that specialized learning in its ideal form has the goal of creating a space for individualizing a creative educational trajectory that subtly combines classical methods of higher music education with modern pedagogical methods, personal achievement and self-development, and the integration of digital technologies into learning (Pećanac et al., 2016). Such an ideal remains relevant, although it has experienced some correlating influences, including those related to the introduction of distance learning, which is based on independent work more than standard forms (Laufer et al., 2021). At the same time, the vector of education of professional musical competencies for applicants for higher education in the musical arts, which focuses on high ideals of understanding artistic canons and receiving artistic education in accordance with the organic use of synthesis of cultural and historical experiences with the innovative potential of modernity, including the appeal to information and communication technologies (Scripp & Gilbert, 2019), becomes adequate for modern conditions.

If we resort to comparisons and past times of pandemic and related global quarantine restrictions, the use of digital technologies in teaching music and instrumental arts in the university environment has several advantages: interactivity, integrality, psychological comfort, appeal to professional-pedagogical practices, the art of ergonomics, the economy of work organization, etc. (See Figure 1).

Figure 1

The Main Advantages of Using Digital Technology in the Teaching of Music and Instrumental Art



Source: authors' own development.

The main elements of the digitalization of music education researchers call the emergence of high-quality online services for teaching music via the Internet. On the one hand, allow you to choose the right digital learning content to work online, but also integrate with modern university educational programs to train highly qualified specialists in instrumental performance. Learning services are based entirely on advanced information technology to address the shortcomings of modern music university education, emphasize the features of interactivity, support the operation of multisensory simulators and various instrumental computer stimulators. The creation and management of digital resources for music education is the foundation of digital music education applied in higher education. The creation and overall standardization of digital music education resources that address the needs of higher education applicants, university and conservatory faculty, and potential stakeholders is essential to the management functions of digital music education tools.

Once appropriate digital resources are formed for online use, they must undergo certification of shared and common-use capabilities, remediation of deficiencies, and content editing. In fact, the use of digital technologies means that only standardized resources are needed import, share, and manage learning on digital platforms.to store, publish, import, share, and manage learning on digital platforms.

At the same time, the latest technological processes have significantly expanded the boundaries of the formation of professional competencies among applicants for higher music education, contributed to the diversity of arts and education pedagogical processes, significantly dynamized them (Park, 2021). So, the change of roles among the students at music universities and conservatories was ensured - they turned from the state of passive listeners into active participants of the educational process, who are ready for independent and competent performance of their duties and self- development. Overall, the current stage of higher music education has seen a gradual shift away from professional gnostic learning (which is based on pure knowledge with a minimum of practical experience in using it) (Ozoaghuta, 2019). Recent trends favor the implementation of a personal and activity-based approach related to the analysis of potential ways to harmonize the educational process through a balanced socio-personal

orientation for students (Mas-Verdu et al., 2020). Due to this, modern methods of teaching operate with such notions as the fullness of reflection of the main values on which culture is based (such elements as science, art, religion, traditions of folk culture and pedagogy, etc. are spoken about), and also - productive and debugged cooperation of all participants of the educational process, the realization of the main functions of teaching (informational-cognitive, developing, social- transformation, culture-creative, search-and- transformation, etc.) (Mas-Verdu et al., 2020). In practice, this transition means that the main goal of the current higher music-instrumental education is the formation of applicants' sufficient knowledge and skills to establish an active professional activity, which will also become an engine for their own development and self-improvement in the future, that is, it is said to obtain the necessary level of professional competence.

The personality approach focuses on the formation of behavioral characteristics and the acquisition of competencies (Mas-Verdu et al., 2020). At the same time, the main problem that is solved during the training is the identification of personality traits in students, which can become a prerequisite for the further successful use of professional skills. For this reason, the acquired competencies become the main behavioral aspects and characteristics that can manifest in effective and successful actions according to the applied context of actions, organizational factors, axiological principles of the environment, as well as the applied parameters of professional activities (Kachur et al., 2021). For applicants in the instrumental-music profession, using the ideals of the functional approach, professional competence at the present stage can be considered the performance of their duties at a high professional level. This is due to higher education applicants obtaining a thorough knowledge of the music profession, successfully using it during practice (Franco & DeLuca, 2021). Therefore, professional competence for future instrumental-music performers in the conditions of digitalization should be considered as integrative qualities, which are distinctive features of the obtained knowledge on specialty, acquired skills and abilities, which are formed in accordance with the personal qualities of each applicant during the professional training in the framework of the art university. conservatory and further qualitative performance of their professional duties.

Modern changes in educational paradigms have entailed the fact that the professional training of applicants for higher music education has become much more multidirectional than before. Specifically, we are talking about the emergence of updated functions that integrate the digital applications of modern technology in music-instrumental education under new circumstances (Daubney & Fautley, 2020). First of all, it is the software and methodological support (in different forms

- media or tools of learning work), which has become the reason for more effective mastery of practical learning material by students in the classroom (Cayari, 2017). For this reason, art institutions of higher education and conservatories faced a new challenge - to find possible options for optimization in the ratio between professional and digital competencies for higher education applicants. this element is also noted in the Framework Programme of the European Union member states on the renewal of key competencies. The document, as interpreted by researchers, refers to the definition of digital competencies as confident, critical, responsible use and interaction with digital technologies during the learning process, professional employment (work) and in social and public life, personal self-development, etc. (Anggraini & Handayani, 2022). Digital competencies are characterized by the following parameters: digital and information literacy, acquired skills in communication and digital communication, collaboration and new content formation (including using programming elements),

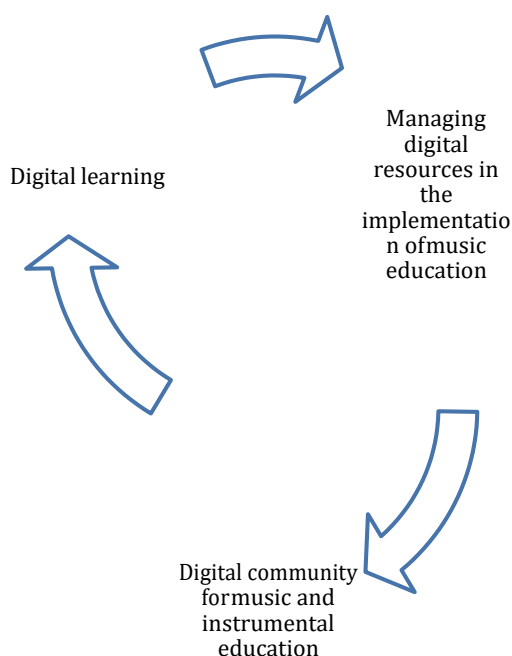
acquiring knowledge of cybersecurity basics, and the ability to solve digital problems at different stages of their occurrence.

Digital Learning Technologies in Instrumental and Musical Education

Digital learning was an important step in combining information technology with educational programs at universities. Its importance initially was to provide faculty and students with the ability to use computers for more immediate calculations, video broadcasting, animation formation, or other computer effects that would come in handy in solving pressing key and complex learning problems, to help bring abstract theories and principles to applicants for higher music education. Further, it became evident that the digital support platform for music education consists of several elements: digital education, digital management, and digital community (See Figure 2).

Figure 2

Diagram of the Digital Support Platform for Instrumental-Music Education



Source: authors' own development.

Further developments in technology have demonstrated another promising direction for the use of information and digital technology in music education, aiming at a wider use of modern digital technology and methods of using artificial intelligence for learning needs (Bank, 2020). It is about applying computer capabilities, demonstrating collaboration and competition in the learning process using computers, deepening autonomous and asynchronous learning capabilities, and determining the effectiveness of education on the use of computers in general (Camlin & Lisboa, 2021).

The next phase of digitalization of higher instrumental-music education came during the COVID-19 pandemic when an effective combination of theoretical developments and their practical use occurred. During the quarantine restrictions, digital technology became a major tool that helped students during their studies. Educational emphases gradually and definitively shifted from a

partial recourse to digital technology as a definite learning aid to its full application as the main distance learning tool (Daubney & Fautley, 2020). At the same time, scholarly research into the processes of combining digital and traditional teaching methods has rapidly evolved - these trends have become extremely important to the discussion among many professionals in various research fields (including music professionals) (Laufer et al., 2021). In particular, the notion of “integration” has received coverage in several authoritative studies, with experts highlighting several aspects of the integration of information technology for use in the implementation of curricula (Kachur et al., 2021). First of all, it is about creating the necessary information environment for learning, transforming the existing traditional educational structures, and introducing updated teaching methods aimed at the wider use of digital technologies.

Discussion

In particular, scholars have noted characteristic features of the importance of information technology for the contemporary training of instrumental music performers. For example, researchers rightly argue that the digital information environment blurs the boundaries between media, thus performing the personalization of musical performance (Wan, 2022). Thanks to modern technology and the Internet, the medium of learning and listening to music courses has become not just part of an elitist worldview, but accessible to a huge number of people - more student involvement mathematically increases the chances of acquiring and nurturing truly gifted instrumental performers (Park, 2021). The popularization of technological innovations and the digitalization of music have transformed the means by which people are introduced to music (Ozoaghuta, 2019). The process of instrumental performance and music writing is also no longer closed to the broader society because today, thanks to computer programs, many people can create their own tracks and compositions, which requires experience not only in the direct performance of compositions but also in arranging and digitally processing them.

Evaluating music is the beginning of stimulating and writing new music. Thanks to digital technology, many will become later participants in the process of creating musical works using a variety of forms (e.g., melody writing, song lyrics, direct or indirect commentary, etc.). Therefore, in the future, during their studies at music universities, students will acquire the skills of teamwork and collective creation of new compositions using the composition of live performance and digital elements.

Also, a peculiarity of the new information and educational environment in higher music education institutions is that it does not oblige applicants for higher education to be “aesthetic” in the direct study of theory and practice. In traditional music education instruction, teachers typically focus on the appreciation and perception of instrumental and musical works, while disregarding the ability to create music independently (Park, 2021). At the same time, during instruction, students as creative people also want to demonstrate themselves and their own knowledge and skills through creativity rather than reproducing previously written works. New media environments allow students to choose their own ways to disseminate and share information to express their creative interests (Kachur et al., 2021). Digital technologies also allow one to distribute their compositions using special applications so that potential audiences can view and evaluate them accordingly.

For example, a popular digital application today is Notion 6. The main purpose of this software is to generate melodies and sheet music. Users of Notion 6 note that it is easy to install, easy to use (subject to getting used to the interface), and the instrumental performance samples offered by the developers are among the best and most promising in the world. Overall, the potential of this digital application

requires further disclosure, but from a professional point of view Notion 6 is capable of competing with the best and most expensive programs for creating your own musical content in any price range.

The program's interface allows you to view the time code of a song, adding the necessary markers for the potential location of future sound or other effects. The video window also has special transport buttons that allow you to work in a convenient format-no need to leave the video window to start or stop recording, etc. An additional advantage of this service is the original and very basic library of musical instrument samples, which is very important for music education. The developers of Notion 6 have installed individual samples from popular performers (musicians and entire orchestras) of today in the library. This includes Steinway piano playing samples, elements of performance by the London Symphony Orchestra at Abbey Road Studios, and selected samples of performance playing by prominent musicians (Wan, 2022). For this reason, applicants to higher music education have a unique opportunity to follow the performance of their score - it will sound as if it were performed by the leading performers of world music. The software allows you to not only listen to but also record your own track in several popular digital formats. Such a mode of operation is important for university projects or other independent activities. Obviously, the digital instrumental-music higher education of the future will integrate with such software solutions, which will seriously improve the performing skills of students, working through their results.

Conclusions and Implications

So, the modern digitalization of higher music education is a relevant process that has been influenced by the introduction of distance learning after the global pandemic of COVID-19. The appeal to digital resources has gone through several stages during its development, each of which has had its own effect on the teaching of instrumental and performing arts to students. In particular, current trends have shown the importance of moving away from previous paradigms of reproductive learning in favor of adopting a personalized approach that emphasizes the creative capabilities of higher education applicants. The advantages of using digital technologies during music and instrumental education in higher education institutions include the action of interactivity, integrality with modern technologies, didactic potential, comfortable conditions for learning and creative work, the economy in the use of resources, etc. At the same time, the use of digital technology has certain disadvantages. First of all, we are talking about the need for additional digital competencies in working with programs and the Internet environment, which should be paid special attention to (as well as certain programming skills required during the training).

Techniques for the use of digital programs in higher education music-instrumental training will evolve in the future toward a larger student audience and the possible collaborative writing of melodies and entire compositions. The use of digital technology is favorable to the development of public tastes and greater contact with potential consumers. The example of the Notion 6 program shows the possibilities of involving such technologies in the educational process. At the same time, teaching methodologies that would unlock the full potential of digital technologies in the music arts remain understudied. Usually, university teachers demonstrate conservatism in their work, which requires additional revision with sound scientific conclusions.

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