Electronic Educational Resources as a Means of Digital Education Development

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Abstract

In the article, electronic educational resources are presented as a means of digital education development in terms of concept, methodology, basic principles of creation, effective and safe use of those resources. Electronic Educational Resources (EER) are considered in the context of the following ordered sequence: *"Information and educational resources – digital educational resources – educational multimedia – cyber-EER - educational cyber systems – multimedia hypertext textbooks"* with their direct and feedback links.

In the research, the specifics of the EER are considered in two aspects: as specialized educational tools and as electronic resources in terms of new opportunities and content. E-learning is based on digital information and digital technology. The article formulates the basic principles of training and use (consumption) of the e-educational resource as one of the key components, in particular, the information and educational environment of subject training, as well as the information and educational environment in general. The essence and concept of digitization of education as a qualitatively new form of presentation of educational information and the phenomena of the world, facts, events, processes in quantitative forms, including numerical ones, are considered.

The most important skill of a person in the digital era is digital competence as an integrated quality of personality, his/her ability to apply digital technologies critically, effectively and safely in all areas of life.

The use of EER in education fundamentally changes the functions of the subject of teaching and the functionality of the teacher in a modern educational institution. In this perspective, the work examines the meaningful and methodical aspects of the formation of personal information culture, critical thinking, culture of information security of the subject of education in the aspect of environmental security.

Keywords [1]

Knowledge, critical thinking, competence, digitization of education, electronic educational resources, information culture, information security, system.

1. Introduction

After the unprecedented development of information, computer and communication technologies in the 20th century, our society has moved into the digital era – the transition which is considered the fourth industrial revolution. At the beginning of the 21st century, we have witnessed the emergence of a network society and digital technologies. Taking into account the main trends in global development, priority technologies include Internet and wireless communications, virtual and augmented reality, distributed content and data systems, neurotechnology and artificial intelligence, creation of robotics and sensor components, etc. The transformation of the modern world fundamentally affects and will continue to affect education, so the education system must respond quickly to the challenges of the time.

The emergence of a global educational space is becoming irreversible, which in turn requires improved knowledge sharing mechanisms, the formation of an information and educational environment and open educational resources as components of the educational space in the *information and digital age.* The urgency of the problem increases against the background of dramatic events in the world around COVID-19, when most educational institutions around the world switched to distance learning in an emergency mode.

E-digital educational resources play a key role in modern education. Without them, it is not impossible to express the content of education and its substantive education systems in accordance with their objectives, the intended results and requirements of the developing information society. The specifics of electronic educational resources and tools can significantly improve the constructive and efficient educational process through forms of digital representation, media reproduction and learning content representation, and improve the quality and productivity of these processes. This requires specification, universalization, unification, conceptual and methodical description in the context of the requirements for them, their implementation in the system of principles of their creation and consumption.

The condition of productive and safe interaction of the subject of education with digital, media educational resources is it's competence, information culture, culture of information security, the formation and development of which should be carried out in their relationship. This interaction also requires its methodical description.

2. Research problem

During the research, the key (initial) points of the problem field have been determined, among which the following have been highlighted:

firstly, the digital revolution has acquired a large-scale character and sociocultural significance that goes beyond technology, that is, it has led to a change in the worldview of a person and human consciousness;

secondly, in the information-digital era, the paradigm of education is changing, there is an active integration of new technologies into the educational process focused on the student personality;

thirdly, the integration of information and pedagogical technologies in education raises the question of the critical use of electronic components and open resources for the purpose of efficiency, accessibility and achievement of educational results;

fourthly, practice shows that the terms "online learning", "e-learning", "mobile learning" are not the same, especially they are not synonyms of the term "open educational resources", since a textbook, teaching materials and others printed publications are also sources of open access knowledge;

fifthly, the use of electronic educational resources significantly expands the possibilities of the educational and cognitive process, however, EER remains an instrument and/or a tool for solving practical problems.

Consequently, at present, a number of contradictions have emerged between the new conditions and requirements in education, caused by the processes of digitalization of society, and the theory and practice of using EER in education, including after well-known events in the world (COVID-19):

- the lack of unambiguity in the concepts of IER and, in particular, EER, without taking into account their specific properties, the peculiarities of their condition, place in the information and cognitive environment and educational interaction with them;

- the lack of a classification description of a variety of electronic educational resources. The concept of EER, like the concept of IER, is structured. Accordingly, structured is its object embodiment in sets of EER with different levels of complexity and functional content. The lack of unification, functional and other orderliness, systematization of the set of EER interferes with the full use of their didactic potential, complicates the orientation of educational subjects in the modern educational cyberspace;

- insufficient attention in methodological descriptions to the socio-cultural and informational and legal aspects of EER as objects of copyright, providing for lawful use in the aspect of information security.

3. Literature review

The increasing importance and popularity of electronic educational resources are being actively developed and discussed in the scientific and pedagogical environment and methodological research in the field of design, development, quality assessment and experience in the use of electronic educational resources in education.

However, in pedagogical and methodological sources, the concepts of "information educational resource" and "electronic educational resource" are interpreted ambiguously and this fact can be traced in a number of works of scientific and methodological orientation.

The question of the definition and role of electronic educational resources in the information and educational environment was addressed by S. G. Grigoriev, V. V. Grinshkyn, L. Kh. Zainutdinova, S. V. Zenkina, A. A. Kuznetsov, S. I. Makarov, M. M. Nimatulaev, I. V. Robert, M. A. Surkhaev, etc.

So, in the work of S. G. Grigoriev and V. V. Grinshkyn, the term electronic educational resource was introduced through "educational electronic publications" for educational purposes [13]. A. A. Karabanov defines an "educational information resource" as a specialized document that meets certain qualitative and methodological requirements for both form and content [29], and in the study of S. I. Makarov EER is defined as a qualitatively new type of educational literature - an educational electronic publication [28].

The next step in this direction is to correlate the didactic capabilities and methodological functions of electronic educational resources with the planned educational results. This made it possible to identify the types of resources, the use of which in the educational process is a priority for the development of the personality, mastery of operational and cognitive resources. So, for example, P. I. Samoilenko and A. V. Korzhuev note "the need for a clear classification and the development of didactic requirements for their application to improve the quality of mastering educational material" [12], while the authors divide all educational resources of distance learning into four groups:
– classic textbooks in the traditional form;
– electronic textbooks and manuals on diskettes;
– multimedia teaching aids;
– adaptive training systems.

Based on the formulated groups of needs of the education system for electronic resources, S. V. Zenkina identified (using the example of subjects of the natural science cycle) groups of tasks that can be solved with their help, correlating the EER with the types of educational activities [10]. And in another work, the author also considers electronic educational resources, but as a key component of the information and educational environment in terms of their didactic capabilities for the implementation of modern educational technologies [11].

L. Kh. Zainutdinova developed a complex of psychological and pedagogical requirements for electronic systems for educational purposes (ESEP), based on the example of general technical disciplines, based on the relationship and interaction of conceptual, figurative and effective components of thinking [9], as the basis for the implementation of open education.

Another approach is also possible, when in order to determine the needs for electronic educational resources, one proceeds from the general goals and objectives of education. Within the framework of this approach, S. G. Grigoriev, V. V. Grinshkyn and S. I. Makarov, for example, believe that the basic needs of the education system for these funds can be grouped into four main groups:

– the needs associated with the need to form certain knowledge that, in traditional teaching, cannot find the required experimental justification;

– the needs associated with the need to master the trained reproductive skills;

– needs due to the need to form skills of a creative type, mastering which students receive subjectively new knowledge by independent search;

– needs due to the need to form trainees' personal qualities that contribute to the development of morality of the younger generation [14].

In many works, the authors (for example, S. A. Khristochevsky, V. B. Yasinsky, V. A. Vul, L. Kh. Zainutdinova) note that an electronic textbook (ET) is a component of IEE and must have multimedia properties, that is nonlinear graphic or audio-graphic presentation of information. However, there is no clear definition: whether an electronic textbook is an information educational or an electronic educational resource.

S. A. Khristochevsky and A. G. Kasprzhak define an electronic educational resource as "a complete set of educational and methodological materials necessary for organizing and conducting the educational process in an ICT-rich environment. It is understood that an innovative educational and methodological complex (IEMC) is designed to modify the traditional classroom teaching system, that is, primarily for the organization of innovative forms of education" [3].

In the works of M. Yu. Bukharkina, S. G. Danilyuk, E. S Polat, I. V. Robert and other researchers pay great attention to the content-methodological, technical-technological and ergonomic requirements in the development of EER. A more detailed picture emerges when substantiating the typology of these means according to their methodological functions (D. Wellington, A. A. Kuznetsov, I. V. Robert and others).

A significant place in the research of I. V. Robert is the identification of didactic conditions for the design of health-saving information and educational environment of the school, special attention is paid to identifying and substantiating pedagogical-ergonomic and technical-technological requirements for information systems and electronic educational resources [6].

The authors are ideologically and problematically closer to the ideology of the definition of EER, given in the work of A. Yu. Lazebnikova & Yu. G. Korotenkov, "as a specialized resource directly aimed at the educational process and significantly influencing its results" [8]. The authors proceed from the fact that the saturation of information resources corresponding to the goals and principles of education is one of the main tasks of education as a whole, and its methodology, and the system of informatization of education, since "it is based on the satisfaction of information, and therefore, cognitive and communication needs of subjects of education" [see: ibid.].

In conclusion, we present the conclusion of the published analytics. In general, the needs for electronic educational resources in general can be indirectly determined based on the analysis of their didactic capabilities (visualization of educational material, increasing the interactivity of learning, access to new sources of knowledge, efficiency of control, etc.), which has been done in general a number of psychological, pedagogical and methodological works. However, it is obvious that such an analysis creates only a general idea of the potential of electronic resources in increasing the efficiency of the educational process.

Currently, despite the fact that over the past twenty years (since 2000) a lot of research works have been carried out in the framework of the development of modern pedagogical theory and practice of the introduction of electronic educational resources, ideas and provisions of e-learning, unfortunately, it must be stated that EER terminology is not yet fully established. The very basic concept of EER is still identified with an electronic textbook (ET), information educational resource (IER) or digital educational resource (DER) and is in the focus of scientific and pedagogical research and the discussion field of educational researchers. The definition of EER requires clarification depending on their didactically grounded application as a means of teaching in the context of digitalization of education.

EER should always have interactivity and a "friendly" interface, it is this property that differs from EER, although both resources are important components of ICEE. Since each educational resource is

somehow associated with a methodological training system, as a component of the information and communication educational environment, the ICEE electronic educational resource acts as a teaching tool, that is, the EER has both content and form at the same time. Consequently, EER has equal components: *informational, activity-based, methodological and documented (metadata) form*. Therefore, the authors are convinced that the essential characteristics and fundamental requirements for EER should be isolated from the general understanding of educational resources in general.

4. Relevance of the study

Electronic educational resources (EER), open educational resources or Web resources available to the user do not guarantee themselves an increase in the quality and efficiency of education, much depends on their presentation and accessibility for the user (for educational subjects). In our opinion, *it's their combined design that allows us to solve important pedagogical tasks: the development of professional skills of both prospective and current teachers based on the active use of ICT in an integrated educational environment that supports the social partnership of all participants involved in this environment: students, teachers, school students* (see: new Federal State Educational Standards). The main danger is the expected natural desire to introduce into OER everything that we have today without taking into account what *school students* will need, what they are interested in, what they will require. The main thing is the *"EER developer" must see a real consumer in front of him, his requests, level of his preparation, future success lies in the choice of the information structure in these resources*.

We consider it urgent to eliminate the above-mentioned problems, which led to the choice of the indicated topic and carried out in this pedagogical research.

5. Goals and objectives of the study

The objectives of this study are:
- description of the information educational resource as a means and product of informatization, open, developed and purposeful for the development of educational processes;
- description of an electronic educational resource, a cyber system as a set of specific information and educational resources with the possibility of a qualitative increase in the degree of interactivity of educational and educational interaction, perception and display of educational information;
- description of digitalization of the information sphere as a qualitative phenomenon and a new era in its development;
- presentation of the concept, methodological principles of creation and consumption of digital electronic educational resources;
- methodological description of information culture as a result of education and means of ensuring information security of the environment and subjects of education.

6. Methodology

The main *methodological* approaches used in this work are:

Content-based and formal approaches aimed at adequate expression of the complex combination of the content and form of a Digital Educational Resource.

Sociocultural approach aimed at adequate expression of sociocultural requirements and information security in EER, the sphere of their creation and consumption.

A systematic approach aimed at an adequate representation of educational resources in the metasystem in accordance with their differentiation, specification and natural relationship.

The *methods* that implement these methodological approaches are: analysis and generalization of the content of philosophical, scientific, pedagogical, and methodological literature; methods of systematization, logical modeling, expression of sociocultural phenomenon.

Statement of the task. To achieve this goal, it is necessary to solve the following tasks:
- to determine the role of electronic educational resources in the educational space as a leading component of the information and educational environment;
- to consider the main types of electronic educational resources and their use in the educational process as a means of teaching;
- to determine the possibilities of electronic educational resources that contribute to improving the quality of education;
- on the basis of the definition of the concept of EER, determine the basic principles of preparation and consumption of an electronic educational resource;
- to formulate the requirements for high-quality, constructive and effective interaction of the subject of education with EER.

7. Results

A number of requirements for the implementation of electronic educational resources have been identified, among which the following can be distinguished: visibility, consistency, problematicity, strength of knowledge assimilation, etc. The principles of preparation and use of an electronic educational resource as an information product aimed at an educational and cognitive environment have been determined. It is noted that as a means of teaching EER meets the needs of education, has a target feature, a degree of universality and adaptive capabilities. The necessity of the formation of a culture of knowledge and cognition, the formation of an information culture and a culture of information security of educational subjects in the conditions of the formation of cyberspace is shown.

The materials of the publication can be useful for prospective and current teachers of educational institutions, computer science, mathematics and related sciences, who train teachers, as well as in the innovative activities of other categories of employees in the sphere of education on the way to improving the quality of education in the digital world and society.

8. Discussion

An electronic educational resource is, first of all, an information resource created and used, and functioning in the social and state environment in accordance with the social and legal norms, ethics, morality, culture, information culture in force in it.

An information resource is defined as an open developing product of human activity in a social and informational environment, which has a wide scope of application, where the following takes place:

- *The property of openness of* this product means that the EEM is open for free use in the environment of its definition and is open for modification, development and addition in accordance with the development of the information environment, the field of education and informatization, in which it is defined and functions. That is, it is open both in relation to its creator and in relation to a potential consumer.

- *The scope of application of an* information resource in the environment of its definition directly and indirectly depends on its functional and customer properties, the degree of its universality and unification, as well as on its internal adaptability to specific conditions of potential use.

- As *a social sphere object,* information resource should be *documented*, which means the presence of an appropriate design, identification of the name and the author's copyright of the creator, with whom it gets responsibility for the potential impact of the resource on the environment.

- *An electronic resource* is an information resource that has an electronic-computer representation and is intended for use in a virtual electronic environment in accordance with the specifics of its organization and functioning. Moreover, it is this specificity that determines the *qualitative properties of an* electronic resource, outside the implementation of which the resource loses (or does not acquire) this quality: it is this *balanced combination of* educational and technological qualities of the EER that

creates opportunities for the reproduction of abstract knowledge and skills in personal intellectual systems, makes it a qualitatively different learning tool.

- *An electronic educational resource* is an electronic resource designed for education or a specific educational system, aimed at achieving the goals of education and subject learning systems. That is, it is an information resource, which is an element of the internal content of the educational sphere, generated by educational processes and aimed at its electronically expressed implementation. "Electronic educational resource (EER) is an educational resource presented in electronic-digital form and including the structure, subject content and their metadata" [30].

In the name of an electronic educational resource, the properties of electronic presentation and educational orientation are mutually expressive, forming an integrated combination, therefore the title "*Electronic Educational Resource*", EER, is more appropriate.

Since the electronic educational resource is open, the scope of its application is potentially all education, regardless of its initial purpose: "…an information educational resource (IER) is a comprehensive training tool developed on the basis of Federal State Educational Standards (FSES) that provides all types of educational activities and allows for an individual-activity approach to the process of purposeful formation of professional competencies in the relevant subject area" [23].

The applicability of EER depends only on its functional completeness, quality of performance, and degree of versatility. Since the scope of application depends on the measure of its functionality, universality and unification, adaptive capabilities, then integrated, multifunctional EER is preferable for mass use in the educational environment. Such electronic resources as, for example, the "Multimedia Textbook" [5], with a developed interface are created on the basis of multimedia, hypertext technologies that combine intellectual capabilities, color graphics, animation, design, musical accompaniment, and highly developed navigation.

At the same time, in local educational environments and for subject learning, mobile low-functional resources are no less in demand, purposefully focused on achieving specific goals, planned learning outcomes (as a requirement of the Federal State Educational Standard) and better taking into account the specifics of subject-oriented teaching methods. In fact, it turned out that even the available content does not always correspond to the needs of the learners due to lack of material or limited language capabilities, etc.

UNESCO policy recommendations in the field of mobile learning is emphasized that "despite the possibility of "migration" of the training materials of the computers and books to mobile devices, developers need to think in terms of mobility and, already on the basis of this, to make serious decisions about the content revision to use on devices with small screens and limited data entry capabilities" [31]. Such EER, having a specific purpose as a means of subject learning tools, are at the same time components of a *methodological teaching system*. Consequently, the optimal form of preparation (development, formation, implementation) EER are internal processes in the methodological training system in the framework of the paradigm of "*goal – training – use*".

At the same time, the integrated electronic educational resource (IEER) should ensure the formation of general educational and subject competences of the subject of education at the electronic-digital level, including their three components:

- *motivational* as value orientations and needs that determine the motives of the educational and cognitive activity of the learning subject , including electronically expressed;
- *cognitive* as knowledge providing: the formation of a scientific worldview; competence, including informational; development of intelligence; the formation of subject, meta subject and personal skills and abilities;
- *organizational* (operational) as universal methods of activity, mastered by a person in subject learning and as a result of the implementation of inter subject connections, the order of interaction, including in the digital sphere.

In our opinion, such a definition is the *principle of* preparing educational resources and the system-forming regularity of integrated EER.

Based on the definition of the concept of EER and the requirements for it, the following *principles of preparation and use (consumption) of an electronic educational resource* can also be formulated:

1. The principle of *information conformity, or standardization* – conformity to the properties and requirements of a standard and unified information and software product for mass use: the presence of

standardization in content, in form (expressive forms), in technological characteristics (standard tools and solutions).

2. The principle of *universality, unification, specialization is a* balanced combination of EER in an electronically expressed educational environment.

3. The principle of *multimedia and adaptability*: functioning in any compatible operating computer environment in accordance with the scope of its application; providing tools for adapting work in any specific environment.

4. The principle of *activation and development of knowledge*: providing means of self-activation and restoration of the knowledge base, their perception by the subject of learning, means of self-learning.

5. The principle of *consistency* is the systemic state of each ERM and ensuring its organic implementation (as a unit of knowledge) into the integrated EER system as a metasystem of knowledge.

6. The *socio-cultural* principle – focus on the *socio-cultural* development of a person, information and legal competence, information culture of the subject of education. It should be noted that "information culture lays down the ideological attitudes of the individual, forms his value orientations in relation to information as an element of culture, prevents dehumanization and replacement of spiritual values" [15].

7. The principle of *differentiation*: a balanced combination of mass creation of EER with increased requirements for professionalism and quality of developments; differentiation of the scope of EER in accordance with their certification (expert assessment).

8. The principle of *interactivity* – is the presence availability of an intelligent system of interactive interaction with the learning environment and its subjects.

9. The principle of *ergonomics and information security* (personal, systemic, technological, legal).

10. The principle of *organicity* is the organic introduction of EER into the sphere of their application through increasing the operational and cognitive competence, information and legal culture of educational subjects.

11. The principle of *labor division* is a division in the field of preparation and consumption of ESM, a combination of the massive development of EER with increased requirements for the professionalism of performance.

The modern information and educational environment with a large number of various technical and technological means of information processing, communication, information display (media, multimedia, SMART) requires a completely different approach to the creation of EER:

- division of labor in the very process of its development and creation - each of its differentiated subprocesses must be specialized and entrusted to a specialist in the relevant field (teacher-methodologist, technologist-programmer, layout designer);
- separation of teaching and resource preparation processes.

The teacher should be freed as much as possible from creating their own educational resources. This should mainly be done by qualified specialists, professionals, while the teacher should act as a consumer (methodologically) of EER and, in terms of informatization, as a distributor, tutor, consultant for the subject of learning (and/or students). We believe that teachers can, sometimes need to be involved, to act as an expert on the pedagogical application of EER. It is this approach that can ensure the creation of a universal, unified, standard EER based on educational standards and standards of education informatization. This does not mean at all that a teacher cannot participate in the preparation of an EER in the presence of appropriate opportunities and conditions, but, on the contrary, "all this makes it necessary to develop the skills of future teachers to independently design a subject information and educational environment, the key component of which will be electronic educational resources" [17].

It is known that the electronic representation of information is the implementation of its bit-digital expression, where each bit as an elementary form of information can take one of two values – 0 and 1 in its specific states. That is, each state of a bit corresponds to a binary number (with a binary base: 0 or 1. Any ordered sequence of bits (byte, word of 4 bits, 2-byte half-word, etc.) can correspond to a set of binary numbers (2^8, 2^{16}, 2^{32} etc. numbers), determined by the specific values of the bits and determining the state of this sequence. Therefore, the electronic representation of information is called *digitalization*.

But the essence of digitalization as a phenomenon is not only this. The process of "digitalization" does not end there either.

At the dawn of computerization of the sphere of human activity, digitalization merged with the concept of computing – formally a computer is a "calculator". In our time, computing has receded into the background, information processing is in the first place, and computing is its routine.

However, firstly, routine is necessary, and secondly, numerical representations and calculations retain their independent meaning in computer transformations. Thirdly, the amount and quantitative transformations of information do not have to have a numerical expression (the presence of a linear order as a measure of comparison is sufficient). The digital form of information is quite consistent with such quantitative transformations. Because the number is a measure of the impact of information, containing its system, and is able to move in the quality, we can conclude the following:

The main goal of digitalization is to *represent the quality of information* and the phenomena of the world, facts, events, processes displayed in it in *quantitative forms*, in particular, in numerical ones. I.e. digitalization is a representation of the quantitative impact information to the system containing their social and informational second environment for the subsequent expression of the quality of electronic-computer facilities, its application in the field of information and informative.

Consequently, digitalization itself is a *qualitative phenomenon* (new quality, new format) in the information-computer environment and defines a new *era* in information processing, its communication and display, information-computer interaction.

The digitalization of information and the information environment entails a *targeted digitalization of the education* sector, the result of which is an increase in the efficiency of the educational process and the optimization of educational interaction through effective and safe, electronically expressed information and psychological impact on each subject of education, ensuring his personal development and self-development. Information and educational resources (IER) and EER, as products of digitalization (phenomenon and era) of education and its teaching tools, acquire increasing opportunities to *implement the qualitative impact of educational information on the subject of learning as an integrated result of its quantitative impact on him.*

To implement the task of its qualitative impact, the EER must contain additional information necessary to ensure interactivity of interaction with it and to express the basic educational information by means of electronic digital representation, reproduction, display. This information serves as a *catalyst* in educational interaction with EER, increasing the level of its constructiveness and productivity: improving perception, understanding, assimilation, memorization. "At the moment is the establishment of a visual way of thinking, in which there is unity of the logical-verbal and visual-figurative, intuitive perception of the world" [19]. Digital communication systems "allow you to quickly and efficiently fill your consciousness with visual images and impressions" [18].

One of the indicators of digitalization as a phenomenon, the level of its development, as an era is the *media state of the* modern information environment. As the author notes, "the media include the widest range of means and channels of communication that serve to transfer all kinds of information. It is an integral, self-organizing substance that is like blood vessels. permeates the entire social organism, all spheres of our life" [24].

Media in the modern sense is a systemic trinity of three components of its components: *media information - media technologies - media communication*, where each of them cannot exist and function without the others. That is, each of the three components is formed and develops in accordance with the requirements of the others, and each component, in turn, presents them with its own requirements.

In each specific implementation, the trinity of media information, media technology and media communication are manifested in the media system they generate. According to [22], "media systems have the following specific capabilities: "1) their openness and accessibility; 2) hypertext nature ...; 3) interactivity ...; 4) efficiency and measurability of all communication interactions; 5) multimedia; 6) posttextuality and postvisuality".

As a specialized area, the media environment of education is distinguished, generated by *media resources intended* for education and created within the framework of informatization of education. Media resources can be as local media objects, the purpose of which is a specific subject learning system, but having opportunities for widespread use, a standard expression of organization and construction, and also open for mass consumption. They can be implemented in the form of complex

multifunctional media systems, media-EER, possessing both the properties of universality and the properties of unification and specialization. Media-EER has an electronic digital representation and computer execution, that is, it is a multimedia tool and a cyber resource, or cyber-EER as an element of "cyberspace" [4], [7]. Cyber-EER provides for mapping to media devices and, therefore, compatibility with media technologies and media communication means. Means of *multimedia* and *hypermedia* provide figurative effects and information display, "the time of linear texts passes, they are replaced by hypertext saturated with visual images or even global intertext, interactive cloudy virtual space" [21].

As an *intelligent system*, cyber-EER operates under the influence and control of a computer, which activates it, using the peripherals supported by it to display information in multimedia form.

In view of the increasing importance of the educational media environment, it becomes not only a means of education, but also its object, the subject of information education and/or *media education*, which is both one of the goals and a form of modern education, having a dual, interdependent orientation:

- on adaptation of the subject in the media environment, the formation of his skills for the productive use of its resources, media competence;
- on the educational process and information and educational interaction in order to increase their effectiveness through the use of the resources of the media environment, their qualitative and quantitative impact on the personality of the subject of education.

That is, in a narrow sense, media education is part of education with its own goals, and in a broad sense, it is a form of modern education that includes media education in a narrow sense and is based on it, its results.

Consequently, the media environment and its elements can be both objects of information media education and subject learning, and their means of education based on the results of media education.

Media competence is the result of mastering the knowledge and skills of a person to work with media objects: search, transfer and productive use in the aspect of "appropriating" their content and obtaining derived information; it is also the ability to adapt to the conditions of the media environment. This is, first of all, the media competence of the consumer of media resources, which is necessary for him as a subject of education to increase the productivity of interaction with the media environment. The higher the level of media competence of the subject of education, the more opportunities and potential he has to improve his level of education (media education), including self-education.

We agree with the authors' opinion [20] that, that the "educational media environment must be *student-centered environment* in which:

- substantial information support of educational processes has been implemented;
- taken into account the personal characteristics of the interaction of subjects of education with its elements;
- psychological support of the process of personal development is carried out in interaction with the socio-cultural resources of".

At the same time, the adaptation of the subject in the media environment presupposes not only the presence of skills in working with media systems, but also the presence of a *personal culture of relations in the media environment,* media culture of the subjects. Personal media culture is a means for enhancing the general culture of the subject, his information culture, forming part of it.

The personal media culture of the subject of education includes his culture of activity in the media environment and the culture of perception of media information. It expresses the level of development of the individual, his ability to perceive, analyze, evaluate media objects, media arts, to assimilate the knowledge of the environment and the formation of personal knowledge through the media environment.

Consequently, the media competence of the subject is, on the one hand, the technological implementation of his personal media culture, and on the other hand, the personal potential that ensures its formation and development.

The personal media culture of the subject is an integral part of his general culture, personal information culture, which accumulates the culture of information activity, information interaction, subject and object relations. "In order for the opportunities created by the information society to be effectively used, a *new information culture* adequate to these opportunities must be formed in the

country. It is she who will determine new forms of interaction between people - both in their business activity and in everyday life, which will change the traditional stereotypes of their behavior" [16].

Electronic digital representation of the information sphere, on the one hand, makes new demands on the general and personal information culture, media culture, on the other hand, it provides new, effective ways and means of its formation and reproduction in the development and self-development of educational subjects.

However, "along with this, the requirements for e-learning subjects, learners and educators, for their competence, knowledge and culture, the content and organization of their activities, and interaction are increasing. Requirements for the learning systems themselves (subject and interdisciplinary) and for education in general are growing" [25].

One of the most important components of the subject's information culture is the *personal culture of information security*, considered in two aspects:
- security of the information environment and its components, tools, resources, technologies; security of personal information of subjects;
- safety of subjects of the environment, both physical and intellectual: from the possible negative impact of the environment.

The applicability of an information object means the presence of not only its pragmatics, opportunities for effective use, but also security: the environment of this application, its subjects and the object itself. That is, the presence of objective qualities of an information object and subjective qualities of its consumers is assumed. Personal culture of information security is formed and develops throughout the educational process, in all educational subjects.

Information security of EER and other resources presupposes the existence of a system for their protection based on information law and social norms, following them and observing them. Consequently, personal information culture, including information security culture, is based on *knowledge of* ethical, moral, social, legal norms, order and rules of optimal behavior in the environment. They are formed in the systems of teaching computer science and other educational subjects, developing in active practical interaction in the information and cognitive environment "... modern information and educational tools and resources are becoming predominantly electronic, multimedia, have a presentation in the form of hypertext, acquire signs of a cyber system. At the same time, the subject must possess not only information and communication competence increasing in volume and quality, but also social, informational and legal, which provides for knowledge and observance of the relevant social and informational legal norms" [1].

That is, they are formed and developed on the basis of information competence, being its continuation, a *qualitative transformation*, demonstrating the transition of quantity (quantitative impact of the environment and personal self- influence) into quality. "The difference between the formation of information and legal competence of university students from the formation of traditional qualities (knowledge, skills, abilities) is the presence of such characteristics as the professional and personal qualities of a student, the correlation of information and legal competence with the value and semantic characteristics of the individual" [27].

Personal information security of subjects of education is ensured both by the means of the environment and education, and by their competence, knowledge of the order of information and computer interaction, information culture, culture of information security.

It is necessary to form and develop *critical thinking of the* subjects of education, which presupposes the presence of their own scale for assessing phenomena, events, environmental processes in accordance with moral, ethical and other attitudes. Since a person's thinking and all phenomena of the environment have an informational expression, the expression, pragmatic implementation of his critical thinking is a *critical attitude to information*: the subject's ability to evaluate it for quality, reliability, usefulness for the environment and his personal development, corresponding to the assessment of the *semantics and pragmatics of information*.

The development of the media environment and, accordingly, media education is the SMART-environment generated by SMART-tools, SMART-technologies, SMART-communications, SMART-systems.

SMART-tools are independent intelligent electronic digital systems (with built-in intelligence), which, unlike media tools, not only communicate and reproduce media information, but are also capable of processing it using the software technologies embedded in them. *SMART-systems* are

multifunctional devices that are compatible with computer systems in general informatization processes. In the work [26] it is noted that "Smart-systems make the learning process *dynamic*. The interaction of subjects of education with media is becoming more structural and meaningful. Intelligent ("smart") Smart-systems (Smart-resources, Smart-technologies) imply the interactive participation of all subjects of learning in a dialogue with them. In this dialogue, a Smart resource can not only be *reproduced*, but also modified, changed" that is, they are valuable precisely for their pragmatics.

Education is becoming SMART-education, the specificity of which is that SMART-devices and SMART-technologies allow you to process educational information online, directly during its playback, that is, make the process of its demonstration dynamic, more visual, meaningful, complete, interesting and therefore productive. That is, SMART-education and subject SMART-learning allow the widespread involvement of the learning subjects themselves in their processes during the dynamic reproduction of SMART-media information systems.

The requirement of high-quality, constructive and effective interaction of the subject of education with the EER, the cyber system implies the need for appropriate training in the aspect of the following:

1. There is no need to study each EER separately. It is enough to study universal principles and a single concept of working with them in the framework of information education and computer science training, as *well as active interaction* with cyber-EER in accordance with the general or personal training program. At the same time, in each specific case, it is necessary to know the *specifics of* the EER used and the procedure for their adaptation to specific conditions.

2. It is necessary to focus on *unified* teaching aids, EER with unified principles of organization, management and interaction. These are, first of all, universal EER and cyber systems. Local digital assets and resources must match them.

3. It is necessary to classify information resources of education and the educational environment in accordance with the concept of an information resource (social, legal, scientific and methodological), its place and role in the information sphere, informatization.

Each electronic educational resource should be accompanied by a *methodological model* (at the design stage), *methodological description*, presentation (at the stage of creation and implementation), which together can constitute an independent methodological resource. This resource or its components are projected onto the initial electronic educational resource at the stage of its formation, development and consumption, forming a methodological component in it.

It is necessary to "equip" the subject of education with means that ensure, firstly, his protection from communication with poor-quality information, minimization of such communication, and secondly, minimization and elimination of possible negative consequences of such communication. Moreover, it is clear that it is impossible to completely protect the subject from such communication and the corresponding negative impact, and this is not necessary: there is no sense and it is not advisable to arrange "hothouse" conditions for the subject, his development should go into his self-development, and his readiness and desire for this. "Information culture of a person implies not only information competence of a person, that is, the ability to independently find and use information resources of society, but also his high informational motivation desire and desire to use these resources" [2].

Since all our activities and the environment of this activity are systemic, then all information resources are *systemic*, and, therefore, can be systematized (based on the structure). The systemic belonging of a resource in the general metasystem of information (scientific and cognitive) resources means the presence of well-defined attributes of their description, and, consequently, a formal presentation, ordering and search. This allows not only to minimize the work of the subject of education in finding the resources necessary for the user, but also to narrow the area of his interaction with the environment, making this environment more purposeful, efficient and safe.

That is, it is supposed to systematize the necessary digital and other information and educational resources and processes of interaction with them, the formation of personal competence in the implementation of these processes and the awareness of subjects of their educational competence. It is necessary to orient the subject towards standard systems of electronic cognitive resources (sites, portals).

Reliance on formal, systemic and content features of information (information resources) greatly contributes to the conscientious behavior of the subject in the environment, orienting him towards the desired result, although it is not a panacea.

9. Conclusion

Thus, the ordered sequence: *"information and educational resources – digital educational resources – educational multimedia – cyber-EER – educational cyber-system – multimedia hypertext textbook"* is developing in structure and content on the principles of continuity, the implementation of direct and feedback high quality.

Information and educational resources, the EER, as the products of digitization (the phenomenon and age) education and its funds have been gaining ability to deliver high-quality impact of educational information on the subject is, learning how to integrate the results of the quantitative impact.

It is necessary to focus on unified teaching aids, EER with unified principles of organization, management and interaction. These are, first of all, universal EER and cyber systems. Local digital assets and resources must match them.

Required: classification, ordering and structuring of information and educational resources.

Personal information security of educational entities is ensured both by the means of the environment and education, and by their competence; knowledge of the order of information – computer interaction; the ability to critically evaluate information when independently searching the Internet and other sources available to them; information culture and information security culture.

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11. References

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