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MANAGEMENT OF GLOBAL EDUCATION THEORY AND TECHNOLOGY IN A DIVERSITY OF LEARNING ENVIRONMENTS

531.01 – GENERAL THEORY OF EDUCATION

531.02 – EDUCATIONAL MANAGEMENT

The strategic priority: Societal challenges

Synthesis work for the title of Doctor Habilitatus on Education

(based on published scientific works)

Chisinau, 2022

The synthesis work was developed within the Institute of Advanced Research in Anthropocentric Changes of the University of European Political and Economic Studies „Constantin Stere" (USPEE „C. Stere") and is carried out as part of the postdoctoral project „*Investigation of the management theory and technology of global education in a diversity of learning environments*" (no. 21.00208.0807.12) with the support of Government of Moldova.

The composition of the public defense Commission:

(aproved by Decision of Senate of USPEE C. Stere, Report nr.4 din 24.11.2022):

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The defense will take place on **28 December 15, 2022**, at 11^{00} in the meeting of the Commission for public defense within the "C. Stere" University of Political and Economic European Studies, 200 Ștefan cel Mare și Sfânt boulevard, Senate room 600, Chisinau, MD2004.

The synthesis work can be consulted at the National Library of Moldova and /or at the library of "C. Stere" University of European Political and Economic Studies and on the website of the National Agency for Quality Assurance in Education and Research (www.cnaa.md)

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CONTENT

ANNOTATION

Railean Elena Aurel

Management of Global Education Theory and Technology in a Diversity of Learning Environments

Synthesis for the title of Doctor of Education, Chisinau, 2022

The structure of the synthesis: conceptual landmarks of the research, content of the publications, general conclusions, and recommendations, bibliography of 95 titles, 34 figures, and 5 tables. The obtained results are published in 37 scientific papers, among which 14 are Scopus-indexed papers.

Keywords: educational metasystemology, global education, metasystem learning design theory, metacognition, strategies, stratagems, tactics, learning and communication ecosystem, assessment.

Purpose of the study: the conceptualization and scientific foundation of management theory and technology of global education in a diversity of learning environments.

Objectives: the study of the epistemological and ontological landmarks of the management of theory and technology of global education and the argumentation of the problem, the purpose, and the objectives of the research; identifying and describing the complexity of the research paradigm and research methodology of global education theory and technology management in a diversity of learning environments; description of the management of metacognitive strategies from the perspective of the specifics of metacognition and successful learning strategies in pre-university and university education; identifying the role and place of ecosystem models in educational management; analysis of the specifics of management of evaluation strategies.

Scientific novelty and originality of the synthesis work: the epistemological and methodological foundation of the metasystem study; designing and making scientific book projects; identifying and describing issues arising from the impact of digital tools on learning theory; comprehensive description of metasystem learning design theory and practical applicability in formative assessment management.

Main new results: rationalization of the metasystem approach; description of the metasystem learning design theory; conceptualization of knowledge management / metacognitive experiences; metasystem analysis of ecosystem models; management synthesis of evaluation strategies.

Theoretical significance: the epistemological foundation of theory and technology management of global education, by elaborating the theory of the metasystem design of learning, defining the research area of educational metasystemology (metacognitive knowledge/experiences, metasystem design of learning, ecosystem of communication and learning, management of metacognitive strategies, evaluation strategies management) and the argumentative description of the metasystem methodology.

The applicative value is proven by validation of the GAE paradigm (G-globalization, A-anthropocentrism, E-existentialism) through scientific coordination of book projects; the realization of continuous training courses for school teachers and the model of the university course manual, developed collaboratively (which includes tasks and metacognitive activities).

The scientific results were implemented within scientific and educational projects; scientific book publishing; the development of continuing teacher training courses and the metasystem design of university courses. The results are approved by the indexing of scientific works in SCOPUS and WoS, the awarding of scientific works at EuroInvent 2017 and EuroInvent 2021, and the AȘM award in social sciences "P. Bran"(2019).

I. CONCEPTUAL LANDMARKS OF THE SYNTHESIS WORK

Motivation for choosing the research topic. Starting from the societal challenges of the third millennium and from the urgent need to prepare young people and adults for adaptation to the diversity of the educational environment and the multifaceted nature of the work field, the synthesis work has the mission of substantiating the epistemological landmarks of global education from the perspective of educational management. The basic ideas, which constitute the core of the research, are: a) the theories are valid within their context conditions and b) the learning environment - "a place or a community where a series of activities are carried out to support learning and those actors who can attract a series of resources when they achieve this" [1, p. 42] - represents a continuum from the physical environment (including the school educational environment) to the virtual environment (consisting of augmented reality, mixed reality, etc.). Thus, the metasystem perspective of didactic design about the dynamics of the general theory of education and educational management, and their applicability in a diversity of learning environments, constitute the motivation for choosing this topic.

The current relevance of the issue addressed. The topic of global education can be found in the objectives (O) of the 2030 Agenda, including O4, O5, O16, and O17 [2], in the initiative to develop the skills necessary for the green economy and in other initiatives in Romania and the Republic of Moldova. Global education is a concern of UNESCO [3], GENE [4], UNICEF Moldova [5], etc. According to the Council of Europe [6], global education is a new pedagogical approach that promotes multiple perspectives of deconstructing stereotypes and is based on the learner-centered approach to stimulate a critical awareness of global challenges and commitment to sustainability.

The science of education and educational management faces many problems. On the one hand, "higher education institutions continue to highlight the need to create and develop the skills of graduates, to become global citizens who will face challenging global problems" [7]. On the other hand, the importance of "developing collective intelligence, teamwork and design skills" [8] for the green economy is proven. At the same time, the difference between the concepts of "theory" and "pedagogical model" is becoming more pronounced. Mergel stated that theory is defined as the principles of organization, explanation, and estimation of some phenomena, events, and actions carried out in a period; and the model represents a tested hypothesis. Thus, "the theory can be modified, in some cases - accepted for a certain period and then denied, and the model <...> helps us understand what we can observe or experience directly" [9, p. 61]. In addition, an indisputable fact is the simultaneous presence of today's learners in at least two environments, called the school educational environment and the learning environment. As a result, contradictions, uncertainties, dilemmas, and problems, which offer openings for alternative epistemological, ontological, and methodological interpretations, need to be studied in depth.

Professor Rudic (2016) stated that educational processes are multidimensional and multifaceted. Such processes can be described by taking into account the epistemological, methodological, and technological contradictions within several conceptual frameworks a) from modernism to postmodernism; b) from computerization of schools to educational policies; c) from continuous training of teachers to situationally; d) from the result (product) to the didactic process; e) from traditional pedagogy to non-traditional pedagogy and j) from the measurement of time and space to n-dimensionality [10]. Therefore, the boundaries of global education have been set for postmodernity.

Framing the theme at international and national levels gives rise to an inter- and transdisciplinary context. Brief presentation of previous research results. In the 20s of the last century global education was equated with "*education for a new era*" [11] and innovative ideas emerged and/or were disseminated in many educational centers. According to Brenony's (2004) study, the global education movement was based on the Theosophists' beliefs regarding tolerance and goodwill between peoples and religions, the importance of studying ancient philosophies, and the supremacy of human strength, as well as a brotherhood for truth. The internationalization of the theosophical movement was possible thanks to "*Education for the new era*", the "*New Education Fellowship*" mobility scholarship for innovative teachers, but also the organization of international conferences attended by Maria Montessori, Carl Gustav Jung, Jean Piaget, John Dewey and other promoters of new educational approaches.

However, since 1937, there has been a conceptual decline in the theory and application of global education. Global education leans towards education for society and global citizenship, education for awareness of global issues, social justice, etc. In the Universal Declaration of Human Rights, education is oriented towards "the full development of the human personality and the strengthening of respect for human rights and fundamental freedoms" [12]. The education of the new millennium is accompanied by contradictions, dilemmas problems, and societal challenges. The problem became acute after the COVID-19 pandemic, which amplified the importance of digital technologies, but also the vulnerability of the design of learning environments and/or the affordability of user interfaces. At the current stage, the topic of global education is embedded in international and national concerns and policy documents. The main principle of all these initiatives refers to the transformative role of education for sustainable development and global citizenship.

From the scientific perspective, constructivist pedagogy and the "social administration of the individual" [13], promoted by Dewey and Vygotsky, constitute the source of the theory of global education, and Paulo Freire's pedagogy of the oppressed - a first attempt at greening the new educations. Such hypotheses with an epistemological and ontological foundation can also be identified in the scientific literature in Romanian (e.g., [14], [15], [16], [17], [18], etc.). For example, Antonescu

distinguishes *pedagogical realism* from *pedagogical idealism* and asserts the need to know two realities, called individual and society (in pedagogical realism) and, respectively, the educational ideal - in pedagogical idealism. In his opinion, education is not possible if the psychological, pedagogical, and social nature of the educable is not known.

A meta-investigation into the management of global education theory and technology was carried out by Fuller and Stevenson (2018), who compared the global education movement to "the emergence of a new global orthodoxy in educational policy" [19], the specifics of which is increased standardization, curriculum centering on the basic topics/knowledge, increasing responsibility and using corporate management practices. According to Verger and Curran (2014), a new model of public education management based on school autonomy, the professionalization of school principals, standardized assessment and teacher accountability has crystallized in global educational policies [20]. In recent research, however, the importance of educational theory and technology for "training the global citizen" [21] is demonstrated, and global learning is a critical response to globalization, although "a clear understanding of global learning and how to develop it remains unclear" [22].

In the Republic of Moldova, global education is described from the perspective of the impact of globalization on the educational phenomenon of the principles of student-centric, activation of knowledge, orientation towards the holistic character of education, and the integrality of the approach to educational phenomena [23]. The new education reflects the pedagogical consciousness, but "arises from the types of education that have traditionally been established: intellectual education, moral education, aesthetic education, technological education, religious education, philosophical education, etc." [24, p. 7]. The course "New educations" addresses current problems, but leans towards pedagogical idealism, so that "the coordinates of the human ideal for the population of the Republic of Moldova are the exits from its two fundamental crises: the identity crisis and the property crisis" [25, p. 21]. The problem of educational leadership is approached from the perspective of obtaining the skills of definition, analysis, comparison, synthesis, estimation/anticipation, argumentation, design, and self-control [26]], and meta-education is "concerned" with the conceptualization and design of education for identity [27, p. 9]. At the same moment, the methodology of skills development in digital environments [28], micro-learning [29], etc. are investigated.

The critical analysis of the elucidated works allows us to state that global education is not a simple impact of globalization on education, but it cannot simply be achieved in the school educational environment. Education is formal, informal, and non-formal; and the school educational environment has expanded to planetary dimensions and, at the same time, it has diversified into a continuum of learning environments. However, the novel pedagogical approach is accompanied by multiple contradictions and uncertainties:

- the classicism of pedagogical theory / educational management concerning the dynamics of theories/ideas/methodologies/technologies in the diversity of learning environments;
- the global tendency to categorize education as a universal right opposite and theosophies;
- the idealization of new education in Moldova with pedagogical realism;
- the intention to solve the problem of global education by redefining the terms "global education", "global citizen", etc., about the real needs of the real man and/or society.

In this research work, the first contradiction is studied.

Research problem:

What are the peculiarities of management theory and technology of global education in a diversity of learning environments?

The purpose of the synthesis work is the conceptualization and scientific foundation of management theory and technology of global education in a diversity of learning environments.

General hypothesis: Global education is achieved on a scale of 1.0-3.0, with an escalating tendency of 1.0-7.0.

Research hypothesis. *If we analyze the phenomenon of global education from the perspective of the theory of metasystem design of learning, then we find that educational management is carried out in a diversity of real-virtual learning environments, which represent a global ecosystem of learning and communication in which metacognition and strategies are predictors of successful learning, including assessment strategies.*

The specific objectives for achieving the purpose of investigations of the synthesis work are:

O1: the study of the epistemological and ontological landmarks of the theory and technology of global education, and the analysis of the problem, the purpose, and the objectives of the research;

O2: identification and description of the complexity of research paradigms and research methodology of global education theory and technology management in a diversity of learning environments;

O3: description of the management of metacognitive strategies from the perspective of the specifics of metacognition and successful learning strategies in pre-university and university education;

O4: identification of the role and place of ecosystem models in educational management;

O5: analysis of the management of the evaluation strategies in diverse learning environments.

The synthesis work is based on the idea that global education requires a new pedagogical approach that will take into account the fact that education is produced in a diversity of learning environments. The vitality of global education is determined by the interdependence between motivation, the performance of lifelong learning, and the need for competitive specialists. For these

reasons, it is proposed that the multifaceted nature of global education be studied from the perspective of metasystem learning design theory, which reflects the dynamics of global phenomena.

The epistemological value of the synthesis work is provided by the GAE paradigm (globalization, anthropocentrism, existentialism) which has the role of metaparadigm for the microparadigms: postmodernism and post-postmodernism, liberalism, and the new liberalism, materialism and the new materialism, constructivism and social constructivism. The added value of the theory of the metasystem design of learning consists in the comprehensive understanding of the dynamics of rapid diversification of learning environments in the open education system and their impact on (meta)cognitive mechanisms and models of knowledge management.

Synthesis of research methodology and justification of chosen research methods. The epistemological foundation of the synthesis work is included in the doctrine of globalization, anthropocentrism, and existentialism (GAE paradigm), a fact that allowed the connection of the research methodology to metasystem thinking. The role of globalization is to signal the problem of the deterioration of the school educational environment and the quality of social perception; of anthropocentrism - to identify the problem of the design of learning environments; existentialism - to understand the differences between action and educational activity. The work aims to provide a theoretical and methodological reference framework for investigating the management of global education theory and technology in a diversity of learning environments. The epistemological landmarks of the research are the Metasystem Learning Design Theory and the principles of self-regulation; personalization; dynamism and flexibility; clarity; feedback diversity and the ergonomic principle. In the foreground, the metacognitive performance of the learner is analyzed.

Several methods were applied in the preparation of the synthesis work, among which the following are highlighted: the relational method (at the stage of the development of reference books in the theory of applied learning and design in modern education; metacognition and successful learning strategies in higher education; strategies of assessment, measurement and testing in higher education; learning and communication ecosystem, etc.); the inductive method (at the stage of formulating the purpose and objectives of the research); the deductive method (at the stage of identifying and validating the research hypothesis and the metasystem methodology); the ideal-type method (for the synthesis of key concepts of reference works in: a) metacognition and successful learning strategies; b) the learning and communication ecosystem and c) assessment strategies in higher education); the method of metasystem delimitation (at the stage of studying open educational resources, etc.); graphical representations with Google Books Ngram Viewer; online questionnaires, statistical data collection and analysis methods (at the stage of investigating the respondents' opinion regarding the topics addressed) and others. The novelty and scientific originality of work consist in:

- the epistemological and methodological grounding of metasystem investigations for the management of global education theory and technology in a diversity of learning environments;
- the design and realization of scientific book projects for the updated study of a) the theory and design of learning applied in modern education; b) metacognition and successful learning strategies in higher education; c) ecosystem models of learning and communication and d) assessment strategies in higher education;
- identification and description of theoretical and applied problems that derive from the impact of digital screens on the perception of learning theory and technology;
- a comprehensive description of the theory of the metasystem design of learning in a diversity of learning environments and their practical applicability in the management of formative assessment.

The synthesis paper is developed based on the scientific works related to the research theme, published after the defense of the doctoral thesis, and addresses the main data of the theory and technology management of global education from the perspective of philosophy, pedagogy, psychology, sociology, cybernetics and knowledge management. The paper reveals the metasystem perspective of the addressed problem.

The new direction of research called *educational metasystemology* (gr. meta – with, after, next to, more than; system – a group of elements/components organized under a common purpose and logia – science) or the science of metasystems in education, is determined by the need to investigate in detail the conditions of adaptation and accommodation of the learner to the anthropocentric societal challenges, including the specific particularities of the continuum of the learning environment; the impact of digital screens on the quality of learning design and educational technology; as well as the specifics of teaching, learning, and assessment in the diversity of learning environments and the impact of digital technologies on the duration and quality of university studies.

Educational metasystemology presents a new field of inter- and transdisciplinary research at the border between pedagogy and educational management, concerned with the dynamics of learning theories, the problems of teaching, learning, and evaluation from the perspective of design strategies, monitoring, and evaluation of (meta)cognitive acquisitions; the metasystem approach to educational technologies in the continuum of learning environments; (meta)mechanisms for designing, developing and evaluating innovative technologies and methodologies; psychodiagnostic methods; the metasystem design of learning based on metacognitive knowledge and/or experiences.

The main new scientific results that led to the establishment of the research direction are:

- rationalization of the metasystem approach for learning design and management;

- description of metasystem learning design theory and methodological applications;
- the conceptualization of knowledge management, metacognitive experiences, and successful learning strategies at the pre-university and university levels;
- metasystem analysis of ecosystem models of learning and communication;
- analysis of the management specifics of evaluation strategies.

The theoretical significance consists in the epistemological foundation of the management of the theory and technology of global education by elaborating the theory of the metasystem design of learning, defining the research area in educational metasystemology (metacognitive knowledge/experiences, the metasystem design of learning, the ecosystem of communication and learning, the management of strategies metacognitive, evaluation strategies management) and the argumentative description of the metasystem methodology.

The applicative value of the work results from the validation of the GAE paradigm through a) scientific coordination of book projects, in which teachers from 32 countries of the world, including the Republic of Moldova, participated; b) design, implementation and validation of continuous teacher training courses: "applied learning pedagogy", "learning and communication ecosystem", "evaluation strategies in the real-virtual environment", etc.; c) planning, monitoring and evaluation of the model of the university course manual, carried out in a team and including metacognitive tasks.

The implementation of obtained results was within the scientific, educational, scientific expertise and scientific book editing projects, as well as in the metasystem design of the university courses "*Assessment psychology*", "*Educational psychology*", "*Theory and practice in HRM decisions*", "*Qualitative methods in social research*", "*Project management*", etc. and the modules for the continuous teacher training courses "*Non-classical pedagogy*", "*Computerized assessment*", "Metacognitive strategies for successful learning", etc. made, including in the Republic of Moldova.

The approval of the results of scientific research was produced by the indexing of the works carried out in the SCOPUS and WoS databases, as well as in the evaluation of monographs and books coordinated with gold/silver medals at EuroInvent 2017 and EuroInvent 2021 and the awarding of the AȘM prize in the field of social and economic sciences "*Paul Bran*". The results of scientific investigations have been recognized and accepted at national and international forums, such as ICVL 2022, ICEAM 2021, the Moldavian-Polish-Romanian International Congress "*Education-politics-society*" (2021), SSRE Congress 2020; TALE 2020, SLERD 2020, etc.

Keywords: educational metasystemology, global education, metasystem learning design theory, metacognition, strategies, stratagems, tactics, learning and communication ecosystem, evaluation.

II. CONTENT OF PUBLICATIONS

2.1. THE EPISTEMOLOGICAL FOUNDATIONS OF GLOBAL EDUCATION THEORY AND TECHNOLOGY MANAGEMENT

2.1.1. Global education as a result of globalization

The concept of "global education" has been known since the twenties of the last century under the theosophical label of new education. In Romanian scientific literature, Professor Antonescu from the University of Bucharest wrote about the importance of pedagogical realism, emphasizing the importance of knowing two realities: the individual and society, on the one hand, and pedagogical idealism, on the other. However, more often than not, global education has been equated with the internationalization of education and, respectively, with the phenomenon of globalization. For example, Tye [30] asserted that global education is the result of globalization. This phrase was also accepted in the Republic of Moldova. In our opinion, the analysis of the concept of "global education" can be interpreted from a philosophical, pedagogical, and/or sociological perspective.

Philosophical perspective. The philosophy of global education is, in fact, the philosophy of educating the person that can adapt to anthropocentric changes and societal challenges throughout life and that are designed, monitored, and evaluated in a diversity of learning environments. Such environments are created through digital technologies and are ensured by the hyper-connectivity of society, characterized by the amplification of ways of connecting people, organizations, and things.

However, some scholars noted that global education should be equated with education for a global society, global citizenship, global skills, global citizen skills, and others – with collective intelligence, teamwork, and learning design skills. At the same time, the title of a global citizen is given to the humanoid robot Sofia who can learn and communicate. These and other uncertainties emerge in the following philosophical questions: a) What is learning for man and society? b) What skills must be developed for the sustainability of education? c) What is the important personality model for the new generation? These and other philosophical questions are not new to the Eastern European space either, being addressed by Antonescu (1943), Lupașcu (1992), Neacșu (2010), etc.

The scientific work [31] represents a narrative reflection on the philosophy of global citizenship education. Initially, it is noted that philosophical questions are interrelated so that what is acceptable to a person, social group or community should be useful to human society and vice versa. However, the philosophy of global education refers to the way we perceive, interpret and construct a pedagogical reality. The term "global citizen", synonymous with "citizen of the world" and "cosmopolitan", describes the person who identifies with the evolving global communities and whose actions contribute to the construction of the values and practices of that community [32]. In our understanding, "the global citizen is a mobile, dynamic and flexible person who knows and applies

new technologies, learns quickly, is independent of local decisions and easily adapts to external conditions" (ibidem, p. 879). The term "global citizenship" (or "world citizenship") describes a citizen's quality as a member of the world community. Global society (or "planetary society", "international society", "world community", or "global village") is the concept of the development of society in the new socio-economic conditions of informational globalization. However, the term "global society" is not suitable to describe the phenomenon of global education in the context of informational globalization considering that a global citizen is a person who lives and develops in an open and interconnected society, but in which disagreements occur and are necessary to improve society and its subjects. Much more important is that any society includes material and non-material aspects and obeys the laws of sustainable management and the global laws of learning.

The pedagogical perspective. Global education is not simply a result of globalization. This statement has several arguments. Globalization is "a phenomenon characterized by the establishment of stable and paradoxical links of a new type between genotype and phenotype, due to the massive technologization of all the existential patterns of the OM, which lead to the "opening of educational systems" and, respectively, to the internationalization of education, but also socio-economic and environmental changes" [33, p. 505]. This definition provides an opening for pedagogical realism, proven by knowledge of realities and formative plasticity (according to Antonescu).

The problem of the global context of education, concerning the reality of the diversification of learning environments, requires the study of realism in the general theory of education and educational management. Pedagogy, as a science of education, needs to be adjusted to the reality of learning and communication with various learning environments and (self-)training and (self-)evaluation exercises, which cannot be successfully achieved without the ability to design, monitor, and evaluate own knowledge. A first argument: "education in the post-COVID-19 period has become a sensitive issue with data regarding the quality of learning of the students and the applied educational technologies" [34]]. But how can this desire be achieved?

The sociological perspective. Under the conditions of digitization, globalization and education constitute two distinct, multidimensional, interconnected, and interdependent social phenomena that result in multiple societal challenges [35]. Managerial solutions must be identified at the level of the individual, social group, community, society, etc. But if we compare the event of fusions of physical, digital, and biological technologies, described by Schwab [36], with the evolution of the "education 1.0-education 3.0" models, according to Salmon [37], we can observe the dynamicity of the phenomenon in the industrial/digital revolutions and educational models (Fig. 1.1).

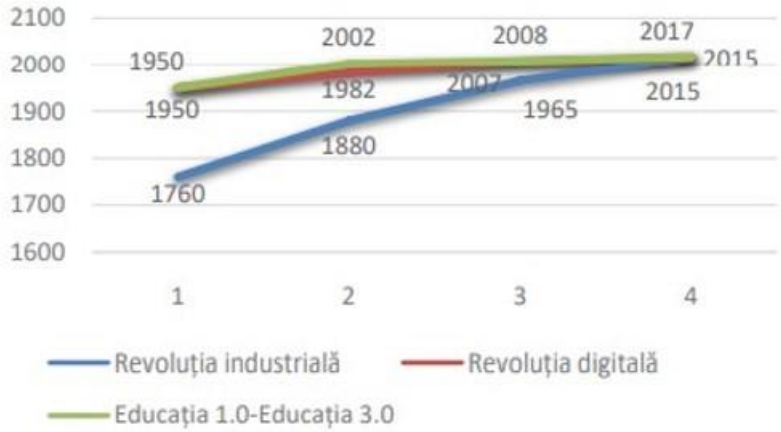


Figure 1.1. Interdependence between phases of the digital, industrial, and cognitive revolutions

The result is materialized in 3D technologies, augmented reality, Google glasses, artificial robots, drones, etc. On the one hand, this result is further proof of the dynamics and interconnectedness of global phenomena and social challenges, as well as their impact on the ability to learn throughout life, but also regarding the sustainability of formal education (proved by the objectives set in the 2030 Sustainable Development Agenda). On the other hand, the dynamics and interconnectedness of global phenomena are important indications of metasystems. The questions that the sociology of education must answer are: What are the risks of the societal challenges of globalization and education in the conditions of data digitization? What skills are needed today and will be in demand tomorrow? What theories are needed for the sustainability of higher education?

Identifying the solution to these questions is not simple because research methods must be focused on categories, taking into account the life cycle of the categories. For example, in the Wordometers environment, the accelerated increase in the share of Internet users can be identified, the rapid increase in online communication activity at the expense of reading published books, the excessive use of digital data with the problem of sedentarism, professional and social concerns, the way of life, the motivation to choose the profession and the correct nutrition, the increase in the number of mobile digitals supports with "personalization of the space", the tendency for digital supports to become intelligent and ecological.

In addition, the analysis of the design models of the digital textbooks allows us to observe the importance of obtaining a synergistic effect in the instructive-educational process, but also the fact that the synergistic effect cannot be obtained through the didactic design of the lesson/university course if the learner is not actively involved in learning management. In addition, the self-regulation of the ability to know is based on the joint effort of the teacher and the learner, but also on the ability to design, monitor, and evaluate the quality of learning through their strategies, methods, procedures and managerial techniques of a metacognitive nature [38].

2.1.2. The effect of the openness of the educational system and open science

In the General Theory of Systems, we distinguish between *closed systems* and *open systems*.

The scientific work [39] highlights that formal education is produced in the school educational system, which is, in fact, a closed type system. Thus, "the closed type educational system represents a pedagogical system artificially designed by a person with purpose, objectives, pedagogical resources, educational means, school educational environment and actors of the instructive-educational process" (Ibidem, p. 687). In such a system the teacher is an expert in the field; the teacher's basic functions consist of collecting, communicating, and managing information from multiple sources and distributing it to one or more audiences; the basic pedagogical resource is the school textbook; didactic processes are modeled as instructional processes with evaluation, regulated by *teacher A* (who leads) and *studen*t(s) B (*who is guided*) through feedback (Fig. 1.2).

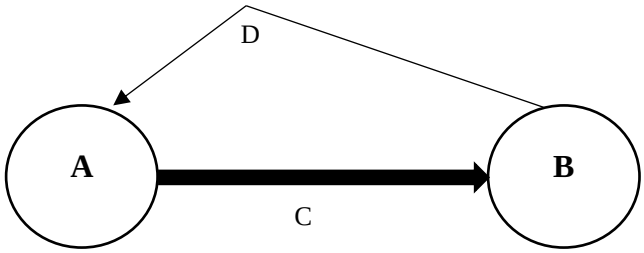


Figure 1.2. training process with feedback (closed system)

To this reality of the educational organization, the classical model of educational management is applicable, in which the school management has the function of organizing the instructional-educational process from system inputs to system outputs. With the emergence of educational management systems and, subsequently, with the increase in the permissiveness of information and communication technologies, there is a shift from classical models to integrative models. The first hypothesis is that "the open educational system consists of input data and output data, information/communication processes, cognitive activity, and evaluation, including from the external environment" (ibidem, p. 688).

For the open educational system, the knowledge management model is applicable. This model describes knowledge as the result of metacognitive experiences in design, monitoring, and evaluation and "integrate information, comprehension, application, and evaluation" (ibidem, p. 696) phases. The purpose of the information phase is to diagnose the initial level (knowledge input); the understanding and application of cognitive acquisitions have the defining role of ensuring continuity between input and output, and the evaluation is to practice and strengthen the cognitive structure obtained as an educational purpose. Therefore, the role of metacognition in knowledge management consists in ensuring the connection between the ability to (self) design, (self) monitor, and (self) evaluate

learning with the requirements of the system (educational, pedagogical, etc.), the (global) society, the environment (educational, learning), etc.

However, although with the opening of the educational system "intelligent corrections" were introduced in the planning, monitoring, and evaluation of educational activities, the two-way mechanism of knowledge remained the same. On the one hand, the effect of openness is also proven by the "migration" of educational resources and teaching aids to the global learning environment, as well as the emergence of open educational resources. On the other hand, there is a tendency to substantiate open science as a solution to the problem of ensuring the permissibility of scientific publications, but not of scientific results. In the scientific paper [40], the trend of open access to scientific works is studied. The obtained results are:

1) Open science is a concept intensively studied since 2012. The prevalence of open science is explained by comparison with the metadata of the United Nations Development Program Report "The Next Frontier: Human Development and the Anthropogenic" - the period that attributes to the human the power to rethink and change behavior and decisions (Fig. 1.3).

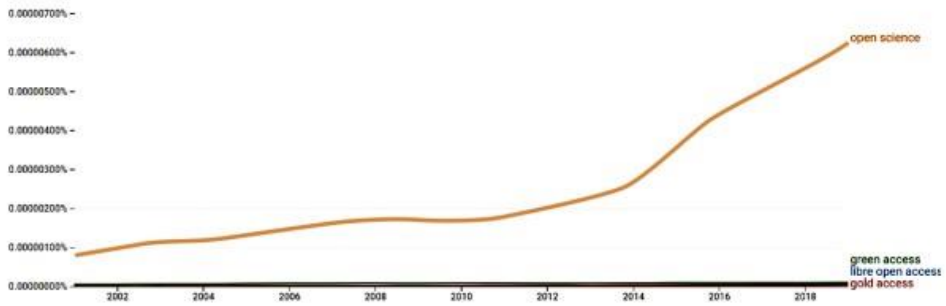


Figure 1.3. Open science to open access models (2001–present)

2) Rethinking and changing behavior and social decisions related to the practice of described science is provided by pre-print opportunities – a technique that adds immediate social value to the publication of recently conducted investigations and their citation (Fig. 1.4).

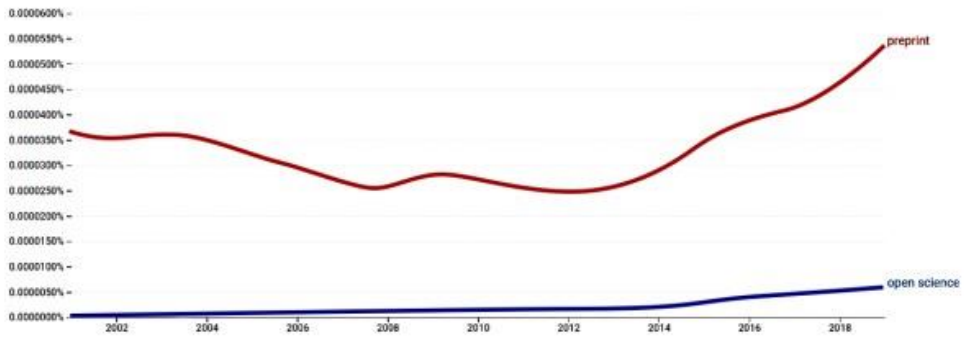


Figure 1.4. Preprint to open science (2001–present)

3) In the digital environment, scientific publications are disseminated in several ways: "gold access" - publication in open access scientific journals, "green access" - placing the author's works in repositories open, the platinum path, free access, etc., the most investigated being the green path (Fig. 1.5).

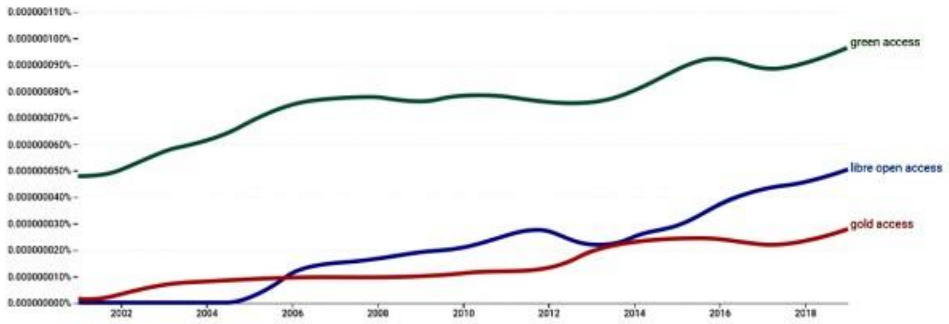


Figure 1.5. Access to the "green way" with the "golden way" (2001–present)

The study identified the valence of the open access resource management problem from the perspective of the opportunities offered by the digital environment, the understanding of the differences between the open and/or free access social movement, and the quality of open publications. The obtained result is of particular importance for the understanding of the design model of pedagogical resources and/or computerized educational means. On the one hand, the instrumental complexes are meant to include or facilitate the transmission of knowledge and the individual way of learning, considering that they include a didactic message or are well structured thematically and "soaked" with audio, video, or hypertext resources. On the other hand, such technologized instrumental complexes are useful for the formation of skills, including in the formation of skills.

The digital environment, by which we mean a virtual or cyber-generated environment, accessed or created using one or more digital devices (e.g. a computer, tablet, mobile phone, etc.), ensures relationality, dynamism, flexibility, openness technological instrumental complexes and, respectively, the rapid dissemination of knowledge in the global community. With the emergence of the digital environment, the so-called digital screens appeared. The term "digital screen" refers to the screen equipped for the projection of digital feature films, using a digital projector.

2.1.3. The impact of digital screens on educational management theory

With the adoption of digital media/screens, there are tendencies to rethink the didactic design model, but these theoretical-applicative attempts are accompanied by multiple contradictions and problems. The contradiction between transhumanism and humanism. The transition from education 1.0 → education 3.0 is in tandem with web1.0 → web3.0. Instructional design specialists' "correction" refers to reformulation. Operational objectives from the training/development of fundamental skills to the "development of sustainable knowledge" (p.13) and from "learning in open and distributive

environments to the innovative application of technology for sustainable development" (Ibidem). At the same time, specialists in philosophy and educational technology accept transhumanism – the philosophical movement dedicated to the promotion of research and development of human improvement technologies, and in innovative research projects, the emphasis is placed on the values of humanism [41]. The solution to this research problem is of global importance.

The issue of user interface design models is illustrated in the paper [42] as a transition from instructional design models conceptualized in a) linear (algorithmic) thinking of the instructional designer and styles of instructional design; b) systemic thinking vis-à-vis the design and development of contents with visual graphics and media elements to c) metasystem thinking (the foundation of Klir's hypothesis: "meta X is applicable as a name for things or systems that are more than X in the sense that they are more organized, contain a higher level of management and can be analyzed in a more general case" (ibidem, p.39)). The facts of the problem are: "learners need to know not only cognitive technologies to complete academic tasks, but also metacognitive strategies" (ibidem, p. 40). In addition, the development of cognitive and metacognitive strategies requires additional (attention-focusing) resources flexibly for the management of the "technological system". The transition from linear thinking to metasystem thinking is further evidence of the dynamics of educational paradigms and educational theories and models, respectively. The problem lies in the understanding of the correlation between educational paradigms and the diversification of user interface design models of digital screens, including their impact on cognitive mechanisms. The solution to this problem is of major importance in the general theory of education and educational management.

The problem of instructional design. This problem was identified in [43] by comparing the specifics of a) teacher-centered and/or b) learner-centered interface design of digital screens. It is observed that, in the design of the teacher-centered digital screen interface, the following are important: visibility, the language of communication, accessibility, usability, readability, and permissiveness of contents. The information disseminated through the learner-centered digital screen interface corresponds to the "system-structure-function" model. The problem of instructional design derives from the fact that the learner-centered digital screen interface design does not take into account the energy of the learner. As a result, the environments created are more immersive compared to the school educational environment and require minimal cognitive effort. In such environments, the so-called "in-demand skills" are important to perform a concrete activity applicable to a situation and at a strictly determined time. For these reasons, it is important to investigate how correct the learning strategy formula is: $Y = D(X)$, where Y – is the pedagogical/didactic/personalized goal set in the learner's action plan, D – the learning strategy, and X –goal (interest, reason, motivation) to learn.

The problem of the correlation between the ecology of knowledge and educational sustainability [44]. Ecology (from the Greek "oykos" - house, dwelling, and logo - discourse) is the science that studies the conditions of existence of living organisms and the interactions between organisms and the environment. This field of interdisciplinary and transdisciplinary knowledge leaves a special imprint on educational management. "The ecology of knowledge refers to the investigation and epistemological theorization of various ways of knowing for the sustainability of education" (Ibidem, p. 81). The research object of the ecology of knowledge includes the structure and metasystem complexity of the links between the learning ability of learners, its maintenance throughout life, and the uncertainties of the learning environment.

What is the correlation between knowledge ecology and educational sustainability? To answer this question, it is important to initially resolve the following issues:

- one-on-one tutoring and/or personalized learning;
- blended, flipped learning or "cognitive scaffolding" interfaces for learning;
- interfaces for interactive or adaptive learning;
- immersive digital environments or/and collaborative assessment?

The solution to the stated question will allow us to understand the instructional design model acceptable to the situation of rapid diversification of learning environments and its management.

The issue of the management of educational technologies within real-virtual learning environments. In the era of digital technologies and artificial intelligence, learning environments need to be designed, developed, and evaluated according to the needs of students to understand both the real and virtual dimensions of learning. Such environments are more attractive to schoolchildren because they ensure learning through immersive experiences created with the help of technology. Educational technologies specific to real-virtual learning environments emerge depending on the permissiveness of smart technologies and, possibly, the rigors of didactic design models. As a result, a large number of more or less educational technologies are developed and disseminated.

Real-virtual environments are dynamic and interdependent, representing a reality-virtuality continuum. The concept of the "reality-virtuality continuum" was described by Paul Migram and his colleagues. In the opinion of these researchers, on the extreme left are technologies that allow the capture, interpretation, and introspective unfolding of real events, and on the extreme right – are intelligent technologies that offer openings to the opportunities of the virtual environment. Mixed reality is constituted by the "mixing" of the reality of the physical environment with augmented reality, augmented virtuality, and the virtual environment [45]. However, in the education sciences, the reality-virtuality continuum has been accepted with the addition of the term "learning" in naming the environment created through digital technologies. Thus, the school environment is transposed into a diversity of learning environments, and the virtual – into the virtual learning environment.

Once the learning environments created through digital technologies build a new reality, there is a lot of talk about the metaverse, a term that defines the perceived virtual universe, the extended reality built from shared 3D virtual spaces. Such a reality may be instructionally designed, but it exists in parallel with physical reality; the connection between the real and the virtual being provided by the avatar. In our opinion, the nature of the metaverse is global, social, and anthropocentric, and "learning" in the metaverse is captivating and has a profound impact on the motivation to learn (Fig. 1.6).

Figure 1.6. Augmented reality at the TALE2020 conference (Me, as an avatar)

Regarding the management of educational and learning technologies in a diversity of learning environments, new theories and models are needed with an emphasis on (meta)cognitive strategies of performance formation and equating ergonomic design with learning ecology, taking into account the fact that each human being is responsible for learning and the maintenance of learning capacity on throughout life, but also by society's norms and culture.

The scientific work [46] is focused on the study of the specifics of learning in the environment of extended reality. Initially, the pedagogical methods applicable to the augmented reality environment were identified: active learning, social constructivism, and trial and error experimentation. As a result of the comparison of the essence of these methods and the analysis of metadata dynamics, it is stated: in the pedagogy of extended reality, the action of the learner is important. This result constitutes the first attempt to investigate the pedagogy of the reality of real-virtual learning environments from the perspective of the interrelationship between pedagogical theories and learning management.

The problem of continuous training of in-service teachers. The emergence of various learning environments and their impact on the quality and motivation of education points to the problem of the continuous training of teachers from the perspective of the need for training, including through self-training and self-evaluation throughout life. In the paper [47] this problem was analyzed from the perspective of the culture of the innovative teacher, which implies the totality of values built through self-improvement techniques, compatible with the cultural valences of environments.

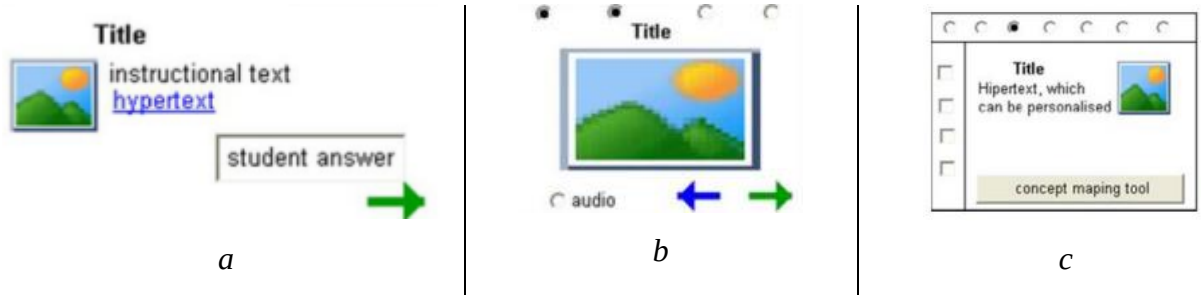
2.1.4. The rationale of the metasystem approach in learning design and management

The term "instructional design" describes a systematic process of translating learning and instructional principles into plans for developing instructional materials, activities, IT resources, and assessments [48]]. The design of learning includes the description of the individuals participating in the learning process, as well as the resources and environments for achieving the learning objectives and the unit (sequences) of learning activities that should be contained in a cognitive process.

The terms instructional design and learning design have been widely used to describe a discipline concerned with improving the teaching and learning process. However, the terms "instructional design" and "learning design" differ in form and content. Thus, "although both terms are used interchangeably and share a common vision, both terms are used to encompass different aspects of learning and teaching" [49]. In addition, learning design is conceptualized in a linear, systemic, and/or metasystem approach. From the perspective of linear thinking, situation A precedes situation B, situation C, ..., and situation N. In systemic thinking, the standardized norms of the system, the holism of systemic interconnections and feedback are valued, and in metasystem thinking – the dynamics of connections and adjustment to the norms of a global society.

The article [50] provides a thorough analysis of linear, systemic, and metasystem approaches to instructional design with and without technologies by exemplifying user interface design patterns and learning environments built with the digital textbook, respectively. Thus, it is proved that “the probability P of the event A given B is maximum if A is the maximum probability of the event B if A then P (A | B) occurs. It turns out that the probability of the event A given B may or may not be equal to P (A). For this reason, to achieve the full probability of the effects of pedagogical scenarios it is important to achieve success in event A, then event B, and so on. Next, to move to the next step, it is important to go through all previous steps. If the answer is incorrect or mechanical errors cannot be evaluated correctly, the learner should repeat framework again and again” (Ibidem, p. 259).

The analysis of the models of pedagogical resources, designed and realized in a systemic approach, allows us to state that "the design and development of the cognitive and behavioral actions of the learners constitute the main problem of systemic thinking. Proposed assumption: correct or incorrect answers must be proven by feedback from different environments” (ibidem, p. 260).



a *b* *c*

Figure 1.7. The user interface is linear (a), systemic (b), and metasystem (c) approaches

Examples of user interfaces conceptualized, designed, and developed in a linear (a), systemic (b) and metasystem approach (c) are presented in Figure 1.7.

The metasystem approach is described in "*Future Research and Conclusions*" as an assumption: "user interface design must be more than instructional or evaluation design" (Ibidem, p. 262). The principles of the metasystem approach are self-regulation of learning (including, by activating metacognition), personalization (as individualization of learning objects), diversity of feedback (as the integrity of immediate and delayed feedback), clarity (as the formation of structural content with concepts strong interconnected), dynamism and flexibility (the inclusion of learners in the instructive-educational process) and the ergonomics of user interfaces and the learning space.

For a better understanding of what has been reported, we will make some clarifications. The concept of "instructional design", also called the design of instructional systems (instructional system design), refers to "a technology that incorporates known and verified learning strategies into instructional experiences for the more efficient, effective, and engaging acquisition of knowledge and skills" [51, p. 2]. According to these researchers, instructional design is the technology of creating learning experiences and learning environments in which instructional activities are promoted. Training involves directing learners to learning activities; guiding them to appropriate knowledge; monitoring learner performance, and providing feedback.

The impact of globalization, cognitization, and digitalization on educational environments consists of the diversification of learning environments. Due to the diversification of learning environments, especially during and after the COVID-19 pandemic, there is a revival of research on metacognition and multiple intelligences, a fact validated by the emergence of new terms, such as Metaverse, meta knowledge, meta ability, metacompetence, metareview, etc. At the same time, there is a global tendency to preserve the classical models in the general theory of education and the theory of instruction; and to apply Taylor's scientific principles – in educational management. The permissiveness, efficiency, and effectiveness of these models to innovative models depend on the conceptual approach to learning design. But global education is not caused by globalization, and the resulting learning environments act in a special way on the primary and secondary cognitive mechanisms as well as the decision-making capacity and problem-solving of human beings.

2.2. METASYSTEMS LEARNING DESIGN THEORY

2.2.1. Framework of Global Education Theory and Technology Management

The research methodology of global education theory and technology management is carried out within a paradigm. According to [52], the paradigm is a complex epistemological construct, consisting of macro paradigms (the highest degree of generalization), microparadigms (the constituents of the macro paradigm), and meta paradigms (a cluster of microparadigms that aim to solve a problem). The global perspective on the multiparadigmatics approach in understanding educational trends and issues is also studied in the work [53]. All these allow us to observe the transition from the paradigm of determinism to the paradigm of synergism.

The multiparadigmatic perspective outlines the scientific management of coordinated volumes in the global environment. Personal contribution refers to the conception, development, and evaluation of project proposals and publication of scientific papers at IGI Global. The idea of the book project is that global education is a phenomenon that occurs in various environments with an irreversible impact on individual and social behavior. The study of the global context of education can be achieved through the joint effort of scholars physically located in various geographical areas, who possess different knowledge and experiences and who apply digital technologies, concerned with the same scientific topic.

The paper [54] aims to study innovation and creativity in applied learning theory and design. The hypothesis of the research is: "innovation and creativity cannot be understood without investigations in the technology of contemporary learning environments" (Ibidem, p. 21). This path is underpinned by the dynamics of metadata. The case study is the textbook – the most widely used pedagogical resource and educational medium. On the one hand, the textbook, analyzed from the perspective of metadata dynamics, can be considered an example of creativity and innovation in various learning environments. On the other hand, the evolution of metadata can serve as a source of creativity and innovation in learning theory and design, as it includes ideas regarding the interdependencies between different clusters. Metadata can be delimited into categories, and defining key concepts can be established for each category. Thus, the dynamics of the metadata can be studied within certain periods and associated with the emergence of global events. A possible algorithm includes the identification of the most cited concepts in the literature during the period of research.

The diagram of key concept categories is presented in Figure 2.8. The key concepts reflect global events that occurred in the area of research in a) philosophy (empiricism, modernism, modernism), b) psychology (behaviorism, cognitivism, constructivism), c) pedagogy (goals, strategy, method), d) cybernetics (feedback, learning analytics, instructional and learning design approaches) and e) educational management (phases, actions, portfolio).

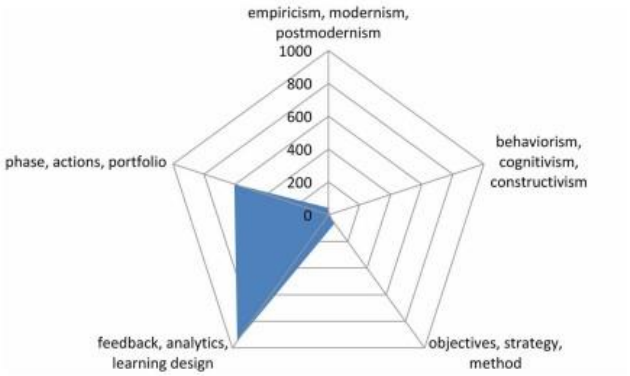


Figure 2.8. Three main patterns in applied learning theory and design

The result was analyzed by the cluster analysis method. For this work, three clusters were identified that correspond to the periods: a) 1888-1960, called the period of the first conceptualizations in the general theory of learning; b) 1961-2011, the period of personal computers and theories of automated training (systemic design) and c) 2011-present, the period of the Internet and mobile media. So,

- cluster 1, named "*Metadata referring to the first theories in applied learning*" embeds scientific concerns in the frontier area of pedagogy focused on modernism, constructivism, instructional objectives, strategy, methodology, educational activity, and actions;
- cluster 2, named "*Metadata that refers to the period of personal computers*" is made up of metadata, based on which the emergence of the theory of creativity, metacognition, the connection between instructional design and feedback, the specifics of non-verbal communication and self-learning can be identified regulated in computerized environments;
- cluster 3, named "*Metadata that refers to the use of the Internet and mobile media in education*", is constituted by metadata that prioritizes the value of the philosophy of postmodernism "dispersed" in multiple directions focused on rationalism, pragmatism, critical thinking, and radicalism (with an emphasis on learning autonomy).

Innovation and creativity depend on the historical period in which they are designed, developed, and evaluated. The GAE metaparadigm represents a complex construct of metasystem reasoning. We can say that the methodology of global education theory and technology management is a set of principles, strategies, and methods that equally offer the teacher and the learner the quality of designer and/or manager of the learning path. It follows that competence, as a set of knowledge, skills, and attitudes, does not have a perfect form. These ideas underpin the development of the work [55] – reference guide in professional and institutional development through project management. Conceptualized as a textbook for a university course, this work describes the importance of the active involvement of all students in the identification, evaluation, and meta-evaluation of the most appropriate project proposal.

Broadly, the specifics of the synergism paradigm include self-regulation, open systems, and nonlinearity. However, in a detailed analysis, carried out by the method of tabulation and graphic representation of the metadata (analyzed on 2.05.2018), the following mental constructions were identified (Table 2.1).

Table 2.1. Hierarchy of paradigms to metadata dynamics

The name of the paradigm	The number of units
Liberalism	212 000
Constructivism	158 000
Humanism	157 000
Modernism	137 000
New materialism	110 345

A deep analysis of the elucidated metadata, with the addition of the term "global education" and the Boolean operators AND, OR, and NOT, leads to the following results:

- the paradigm of liberalism is complemented by neoliberalism, and "neoliberalism constitutes a specific form of educational management" (Ibidem, p.77);
- the paradigm of constructivism "diversifies" into epistemological constructivism, cognitive constructivism, radical constructivism, cultural constructivism, community constructivism, and social constructivism;
- the paradigm of humanism is associated with positivism, posthumanism and transhumanism;
- the paradigm of modernism includes modernism, postmodernism, and post-postmodernism;
- the paradigm of materialism, based on naive, metaphysical, and mechanistic materialism, leans towards the new materialism based on positivism, interpretivism, and criticism.

2.2.2. The study of metasystem boundaries

Philosophical boundaries. The results obtained in the study of the analysis of the complexity of global paradigms can be analyzed from the perspective of the transition of the metasystem. After [56] the concept of metasystem transition was proposed by Turchin (1977) to describe the process of a new level of intelligence and control. A metasystem transition represents a discrete jump to a higher level of complexity. Therefore, any metasystem represents a cluster of systems with a more complex, feasible, adaptive, and smarter construction to environmental challenges, considering that new functions are subject to an external control (Fig. 2.9.)

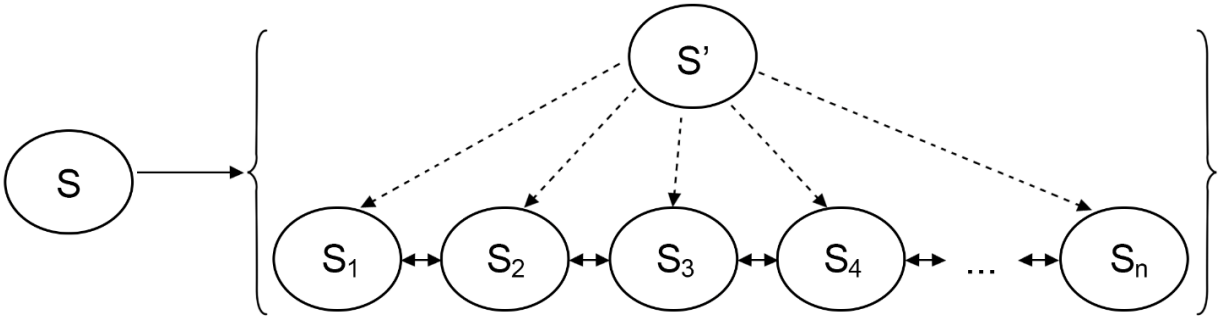


Figure 2.9. The effect of the transition from the educational system to metasystems of global education

In the paper [57] the metasystem is conceptualized as an integrative totality of vital and non-vital systems, "connected" to the diversity of learning environments - the condition of sustainability. The emphasis is placed on the difference between the architecture of knowledge of the *savoir* type (a term from Michel Foucault's Theory, which in translation from French means knowledge) and *connaissance* (translated: knowledge of knowledge). It is concluded that the architecture of savoir represents a purely pedagogical construct, which can be described or built based on Bloom's Cognitive Taxonomy, and the knowledge of knowledge represents the unity of savoir, psychological valences (will, interest, reason, motivation, etc.), intelligence (cognitive, emotional, digital, etc.) and the capacity for decision and action of the learner in a diversity of learning environments.

Any metasystem is complex, open, dynamic, flexible, large-scale, and hyper-connected with other (meta)systems. The global education system has these distinctive features, therefore, it is a metasystem and represents a cluster of metasystems. At the same time, the metasystem of global education is constituted by a multitude of learning environments. This situation is explained in [58] through more deductions, such as a) the elements of the open educational environment are interconnected; b) meta-skills (meta-knowledge and meta-experiences) are important for successful learning; c) the learner needs practical skills of "adaptation" to the uncertainty of learning environments, to the turbulence of data and requires the ability to learn to be developed, taking into account the fact that everyone "has a genetic background in reading printed books" (Ibidem, p. 171).

The study of psychological boundaries. In the paper [59] principles and norms of the metasystem design of learning are explored by analyzing the dynamics of connections between intellect and intelligence. It is noted that the term "intelligence" is used not only to define the mental abilities of human beings (IQ level) but also of machines ("artificial intelligence")" (Ibidem, p. 88). As a result of the fusion effect of physical, digital, and biological technologies, there is increasing interest in the study of the complexity of human intelligence. This idea is argued based on the metasystem analysis of metadata stored in Google Scholar for 1960-2018. The research results are presented in table 2.2.

Table 2.2. Empirical data of the study of trends in intelligence research

		1960-1980	1981-2000	2001-2018
1	Cognitive intelligence IQ	243	447	2250
2	Emotional intelligence EQ	167	6810	11900
3	Multiple intelligence	39	1990	16800
4	Cultural intelligence KQ	63	286	15000
5	Digital intelligence DQ	74	163	2410
6	Ecological intelligence AQ	4	140	1960
7	Spiritual intelligence SQ	58	534	11600

The graphic representation of metadata dynamics is elucidated in figure 2.10.

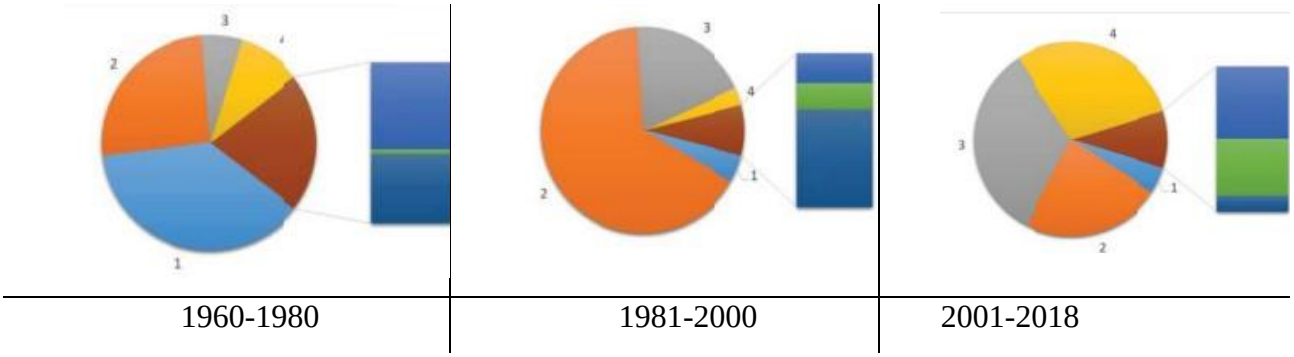


Figure 2.10. Metadata Dynamics of Intelligence Types,

where 1-cognitive intelligence, 2- emotional intelligence, 3- multiple intelligence, 4 cultural intelligence, 5-digital intelligence, 6-ecological intelligence, 7-spiritual intelligence.

The study of pedagogical boundaries. The principles of metasystem learning design can be practically implemented in norms from the perspective of critical pedagogy. "Critical pedagogy is a part of philosophy that capitalizes on the interdependencies between context-determined teaching, learning, and assessment" (Ibidem, p. 49). The metasystem design represents an individual or/and collaborative construction of the digital text that can be extended to the level of understanding through effective control. Such a mental construction can be achieved based on a dynamic and flexible instructional strategy. "The content of each module is structured around information and tasks to strengthen knowledge, cognitive, action, and behavioral skills. The number of tasks is decreasing, and the number of tasks focused on behavioral actions is increasing" (Ibidem, p. 55) [60].

The study of boundaries in management science. The global context of education leaves a special imprint on the science of educational management. However, learning that occurs in a variety of environments is governed by global laws of learning and assessment, and the nature of these laws is behavioristic. The study of global education management cannot be carried out without the metasystem methodology, which allows for studying the dynamics of the flow of ideas from the

principles of scientific management applied in the school educational environment to the situation of the diversification of learning environments. Based on this conviction, the scientific paper [61] analyzes the global transition from scientific management to data-driven educational leadership. The result is shown in fig. 2.11.

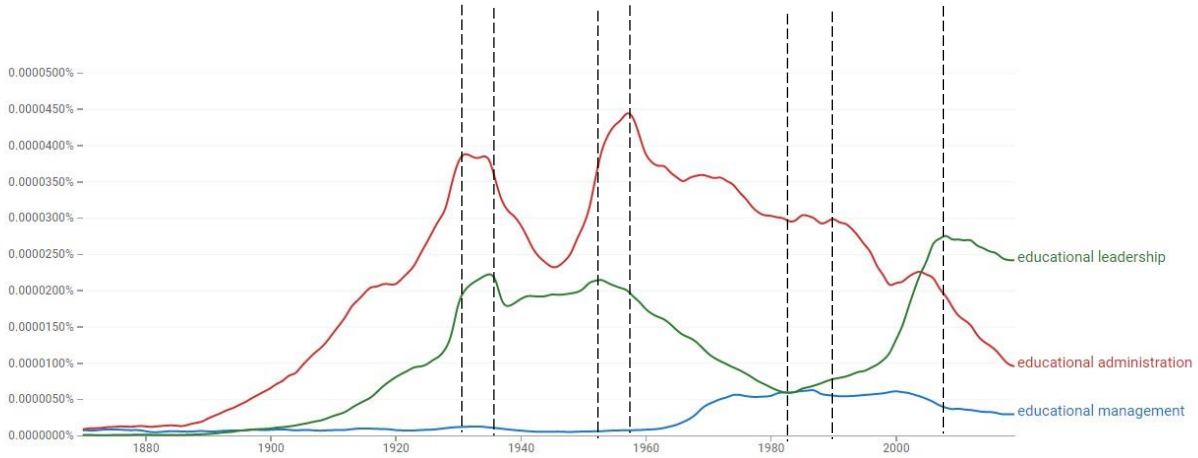


Figure 2.11. Global trends in educational management, leadership and administration theory

The detailed analysis of each stage allows us to state that the principles and norms of scientific management are specific to the period up to the educational management computer systems. The information systems period is important by highlighting the role of educational leadership as well as innovations in institutional management. As a result, until the late 1990s, educational management remained a relatively new discipline with a "widespread shift toward self-management," according to Bush. However, with the emergence of the real-virtual environment, the catalysis of educational leadership research is observed, and the subjects that refer to educational administration and educational management are partially neglected. "The new millennium began with the global crisis of education that 'produces' innovative models of educational management. However, the educational environment is replicated in various environments and learning spaces. Academics developed theories, while education managers were more involved in the practice, but in both cases, innovative ideas are sought" (Ibidem). Therefore, modern educational organizations must adopt a model of hyper-management, which gives each individual the social status of a global citizen and "actor" position in quality management and data-driven leadership.

2.2.3. The metasystems learning design of open textbooks

The metasystems learning design is specific to the open environment constituted using digital technologies. In the monograph [62], the specifics of metasystem learning in the open environment (where open digital textbooks and/or other open educational resources exist or can be created individually or/and collaboratively) are studied. Starting from the idea promoted by UNESCO, according to which global education is equitable, inclusive, open, and participatory, it is stated that

open education is carried out in an action-participatory environment. This idea extends the permissiveness of educational technology patterns in the limit: education 3.0 → education 7.0, whose formula is: E= (E_1, …, E_7), where E1 - education 1.0, E7 - education 7.0.

Education 7.0 describes the model of the educational phenomenon that emerges in a diversity of learning environments due to the power of external control and intelligence. For these reasons, "education 7.0 includes models that are based on the development of spiritual intelligence that focuses on perfection, global security, safety, healthy and active rest" (Ibidem, p. 4). Hierarchically, education 1.0 refers to the opportunity of the static web as a global medium for digital reading and open knowledge dissemination; education 2.0 constitutes the social-participatory web model; education 3.0 offers unique opportunities to create knowledge artifacts and communicate with or through the object of learning; education 4.0 is the exercise of self-regulated learning in the global community; education 5.0 leverages the action, responsibility, and values of the global community; education 6.0 opts for harmony in the global community and education 7.0 is centered on spiritual intelligence.

The openness of the school educational system and/or environment also outlines a new philosophy of transparency, permissiveness, and accessibility of everything, where and how human beings produce, share and construct knowledge, skills, values, and attitudes in the global educational environment. Everything and everyone is connected by data, thus creating an open learning environment on a global scale. Open knowledge is produced if information can be accessed, used, reused, modified, and shared freely. "This global movement is fundamentally changing the way people think, learn, live, work and relate to each other" (Ibidem, p.11). For these reasons the interdependence of open access, open format, and the open license is important.

The phenomenon of the openness of the school educational environment is also characterized by the emergence of open textbooks. "Open textbooks, which are a collection of open educational resources aggregated in a way that resembles a traditional textbook, take many forms and contours" [63]. Most often, open textbooks are the versions of printed textbooks that can be freely read in digital format. However, if we analyze the dynamics of research in the instructional design of these textbooks, we can see that open textbooks have dominated the global educational movement since the eighties of the last century. However, the question of what is and what is not an open textbook is in the eyes of researchers. The result of the comparative study of open textbooks and non-open textbooks is presented in table 2.3.

Table 2.3. Similarities and differences between open and traditional textbooks (p.16)

	Open textbooks	**Non-open textbooks**
Portability and access	Anytime and anywhere with Internet access	
Cost	potentially cheaper than print	
Ecology issues	no paper, no ink, no obsolete older editions	
Availability	Free, but can be reused, remixed, revised, redistributed, and retained	restricted by the norm of license
Flexibility	„tailored" content	conversion in audio/printed format
Readability	different patterns and models of fragmentation and summarization	national education policies
Pedagogy	open education and open pedagogy	classical pedagogy

The term "*open pedagogy*" refers to the practice of using open educational resources, including open textbooks, to support learning or share in the global educational environment teaching practices to improve education and training at the institutional level and/or individual. This definition is specific to the open educational environment that offers unique opportunities for lifelong learning. The first argument derives from the result of the analysis of the dynamics of the "*adaptive learning*" method. Thus, it is observed that at the beginning of the last century, this concept was used to describe the teaching method that facilitated the understanding of what was learned in an artificially created environment, and at the current stage - adaptive learning is equated with adapting to societal challenges.

The dynamics of the terms: "*skills*" (ability, aptitude, skill, competence) and "*literacy*" (the ability/ability to write, read, etc.) are determined by the constants of instructional design, for example, purpose, objectives, didactic process, etc. Instructional design and classical educational management models, respectively, are limited by time, environment, and school space. However, the open environment is seamless so that learning is no longer limited by time and space, but is determined by external control based on data and indicators. The open environment signals the need for liquid skills (the ability to work in a team, time management, communication management, critical thinking ability, etc.). The term liquid skills are meant "the ability to do something well, creatively and innovatively to adapt quickly and continuously to the challenges of the global environment" (Ibidem, p.114) and the fluidity of the labor field. Liquid skills are complex, consisting of technical skills (also called hard skills) and soft skills (consisting of qualifications and competences accumulated over time).

A separate issue is the training/development of scientific and technological competence. From a metasystem perspective, in the global educational environment, a multitude of STEM forms is attested, including STEM, STEMM, and STEAM (where S-science, T-technology, E-engineering, M-math, A-art, M-medicine), but at the same time the transition from STEM1.0 (static) to STEMx (dynamic). "STEMx is a common label for STEAM, STEMM, STSE, etc., where S-Society, M-Medicine, E-environment" (Ibidem, p.144). The STEMx educational activity is focused on training/developing the skills to explore real-world situations in a diversity of learning environments.

Practical applications. Concept map model of STEAM pedagogy [64].

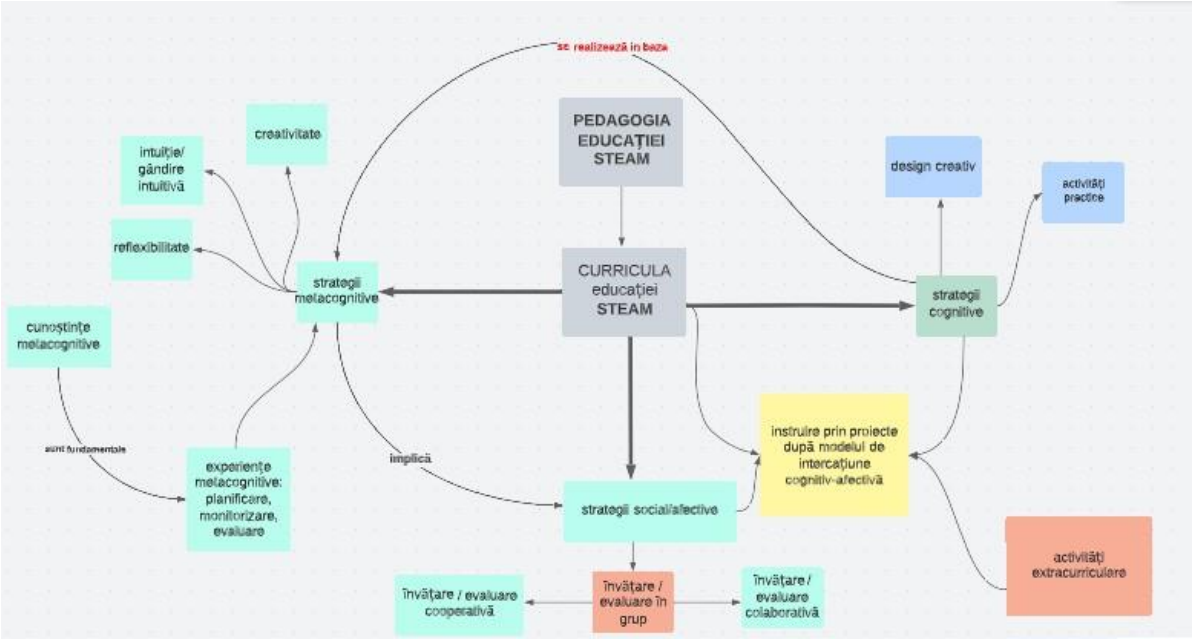


Figure 2.12. Concept map of STEAM pedagogy

According to this model, STEAM education pedagogy is carried out according to the STEAM curriculum. The teaching-learning strategies are diversified into a) cognitive strategies, b) metacognitive strategies and c) social/affective strategies. Each of the listed strategies can be achieved if the learner possesses the competence to learn. Thus, a) cognitive strategies capitalize on creative design and practical activities; b) metacognitive strategies involve metacognitive knowledge and experiences; c) social-affective strategies support the importance of group learning/assessment through cooperative and collaborative learning activities. The emphasis in the STEAM education curriculum is on training through projects and solving real problems according to the model of cognitive-affective interaction (achieved through tasks that ensure interest, curiosity, motivation, etc.). Social-affective strategies incorporate cognitive strategies as well as metacognitive knowledge and experiences into a holistic unit.

2.2.4. Research methods in the management science of global education

The theory of global education is validated by concepts from philosophy, pedagogy, psychology, cybernetics, management, etc. From the perspective of the metasystem learning design theory, management of global education theory refers to the learner's ability to critically analyze and issue value decisions. These methods are qualitative-quantitative. A detailed study of the evolution of scientific methods can be carried out by the method of meta-analysis. Depending on specific objectives achieved, the people, and the intelligent technologies availability, the stages can be named as follows: micro- (individual level), meso- (investigation stage in group, organization), macro- (investigation stage in community/society) and mega- (stage of investigations on a global scale).

In the research paper [65], the issue of the specificity of investigation methods in the diversity of learning environments is analyzed from the perspective of the social perception of the effectiveness of open textbooks by the users of these resources. As a result of the research, it is found that hybrid forms of learning allow for choosing learning strategies and reflecting on the most appropriate learning management strategies. Thus, from the list that includes online reading, case study, group discussions, active learning, cooperative learning, flipped class, participation in seminars, comprehensive reading, and training identified: a) online lectures (33.4%) and b) active learning (26.7%). Thus, active learning incorporates comprehensive reading, problem-solving, collaborative writing, and strategic teaching.

Learning in real-virtual environments highlights the importance of metacognitive knowledge and experiences. To determine whether learners possess such experiences, the following question is included in the questionnaire: “Imagine that you are reading an open interactive version of an educational psychology textbook. After reading a chapter, what is the first thing you will do?” and there are five alternatives: a) I will read the content again; b) I will review the content and take notes; c) I will reflect on the questions and discuss the main points with colleagues; d) I will develop a concept map and e) Others. As a result, the majority of learners choose to review the studied content and take notes (37.5%). However, fewer students reflect on the content studied (25%) and apply concept maps (21.9%). What is the cause?

Regarding the most effective learning methods, respondents' opinions lean towards a) teaching appropriate content (28.1%) and b) knowledge of learning methods and techniques. This divergence of the opinion reveals the increased level of awareness of the importance of metacognitive strategies. At the same time, a small number of respondents (9.4%) consider visualization of learning paths and self-assessment of prior knowledge as important in metacognition. Learners with spatial intelligence value concept maps and those with linguistic intelligence appreciate mnemonics.

An important issue is a connection between metacognitive experiences and the ability to communicate, solve problems, etc. It is observed that most respondents are aware of the importance

of metacognitive strategies, have metacognitive knowledge, and apply some strategies. In addition, for the development of metacognitive skills, they believe that cooperative and collaborative learning and evaluation methods are effective (a fact mentioned by 80.6% of respondents).

Opinions regarding open textbooks that would have elements of metacognition are studied as:

- characteristics of open textbooks that promote metacognition;
- possibility of replacing current manuals with open manuals;
- differences between tasks designed for various activities;
- the importance of strategic questions in human-computer interaction;
- contribution of the open textbook on the quality of metacognitive strategies.

Based on the answers obtained, we conclude that the open textbook is not a version of the printed textbook, but requires a tool for intelligent analysis of the learners' answers, which would provide the opportunity to graphically represent the creative conclusions (38.7%). The majority of those interviewed think that open textbooks will replace traditional pedagogical resources (81.3%). Regarding the differences between the tasks designed for various activities, the importance of learning design (45.2%) and didactic design (41.9%) is emphasized. The goal of metacognitive learning can be achieved through planning, evaluation, and monitoring activities, and therefore the open textbook should include elements of metacognition practice.

2.2.5. Research Methods in Management of Global Education Technology

Global education technology is made up of learning strategies, processes, tools, and objects. The specificity of this technology derives from the global context of pedagogical resources and the permissiveness of learning environments. Research methods are qualitative-quantitative, for example, the study of global trends (Google Books Ngram Viewer), opinion polls, meta-analysis, and others.

The research paper [66] aims to investigate the social perception of respondents physically located in the USA (20%), the Russian Federation (24.9%), the Republic of Moldova (18%), Romania (10.3%), Belarus (15%), Greece, Bangladesh, Spain, China, Pakistan, Egypt, Nigeria, India and the UK (406 respondents in total). The questions relate to the pedagogy theory and management of open textbooks. The results obtained are:

- most respondents accept practices of learning with open textbooks;
- open textbooks represent alternative pedagogical resources;
- respondents most often practice critical thinking for transformative learning;
- open textbooks have a positive impact on self-regulated learning capacity;
- open textbooks are an excellent environment for awareness of the risk of cognitive load and risk management;

- open textbooks offer the opportunity to choose the most relevant learning methods.

However, the methods of investigating social perception depend on the intelligence of the researcher. The problem lies in the dynamic of emphasis from cognitive intelligence to spiritual intelligence. In uncertain situations, learning is goal-directed, rapid, and has long-lasting metasystems outcomes. The selection of methods depends on the performance of the learner to act in the uncertainty of learning environments. Therefore, situational methods are specific to uncertain situations where action and decision are important.

For the article [67], the questionnaire "Teachers' perception regarding educational strategies, methodologies, and practices during the COVID-19 period" was designed, developed, and disseminated online. The items and the form of the answers correspond to the rigors of investigating the global phenomenon/event through the qualitative methods specific to the social sciences. The content of the items was formulated following the proposed items. The questionnaire was completed by 158 respondents - the teachers of the online continuing education courses organized during the COVID-19 pandemic. The most relevant results are:

The form of organization of the didactic process is situational. Respondents opted for distance learning, blended, flipped, active and interactive learning, and other formats. The highlighted problems are from the field of learning management: a) the curriculum adapted to the specifics of skills training during the pandemic period (uncertain situation, the responsibility of the teaching staff, the commitment of the learner), b) the study of the risks of the learning environment/space and risk management, c) the problem of the insufficiency of digital supports, Internet speed, etc.

The most effective teaching methods incorporate interactive group teaching-learning strategies. The majority of teachers opted for interactive speech (60.8%) in favor of the method of working with the textbook (23.4%) and comprehensive reading (8.9%), a fact that argues the importance of cooperative and collaborative methods for distance learning (Fig. 2.13).

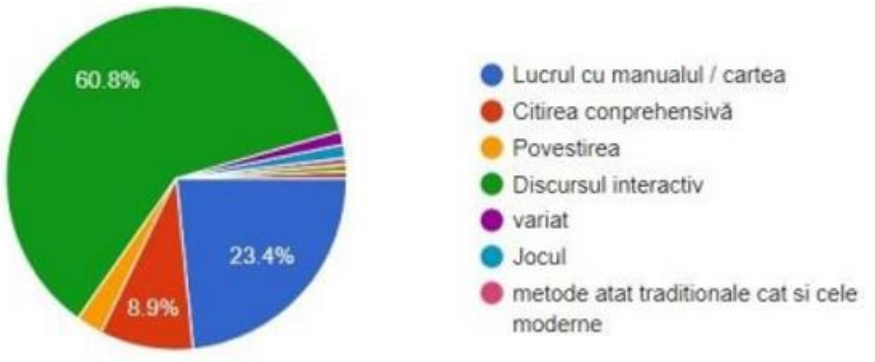


Figure 2.13. Highlighting the importance of interactive discourse

Interactive discourse can be considered an argumentative method achieved through individual, group, or collaborative learning techniques.

The most comprehensive category of methods is the category of transformative learning methods. This category includes action-based strategies and methods (46.2%) achieved through role-playing, project-based learning, etc. The specificity of these methods consists of the active involvement of students in learning. According to the answers of the respondents (25.3%), the methods of exploitation of reality were in second place. The respondents did not deny the importance of methods of knowledge acquisition and transmission (17.1%) in the online environment, but they spoke against scheduled training (4.2%), etc. (Fig. 2.14).

Figure 2.14. Highlighting action-based methods

The teacher's message is delivered quickly and without disruption. The synchronous-asynchronous learning dilemma is solved by the potential of the real-virtual environment to disseminate the teacher's message. According to the data, the most demanding were the video/audio sequences (52.5 %), the transmission of images from the Internet (17.7 %), the development of simulations (10.8 %), and personally developed photos/sequences/text (10.1 %). However, it is not clear whether the principles of ergonomics, design, and control of the learning space, the rules for the use of licenses for open educational resources, the design/sequencing rules of the didactic message, ergonomic rules, etc. are respected in the instructional design.

In school, skills are usually assessed using traditional methods. The issue of evaluation in the global educational environment is a sensitive issue considering that digital technologies allow the storage, analysis, and rapid dissemination of items, but the effort required for the construction and management of items is comparatively greater. Thus, during the pandemic, teachers tested many computerized assessment methods, but the vast majority sent the tests developed on paper through Social Media applications (38.1%). However, 32% of the respondents admit that they have tried the computerized assessment method, and 20.4% - communication through technologies (Fig. 2.15).

Figure 2.15. The prevalence of using paper tests photographed and submitted online

Increasing professional interest in psychopedagogical topics reveals knowledge management. Respondents are interested in studying motivation to learn (45.6%) and successful learning strategies (39.5%). Less importantly they seem to be interested in the topic of distance teaching, computerized assessment, working with parents, etc. Regarding the management of school activities in uncertain situations, the respondents point out a) the lack of an interactive portal for the exchange of opinions and good practices (43.5%) and b) the lack/insufficiency of the assistance of the school psychologist (33.3%), as shown in Figure 2.16.

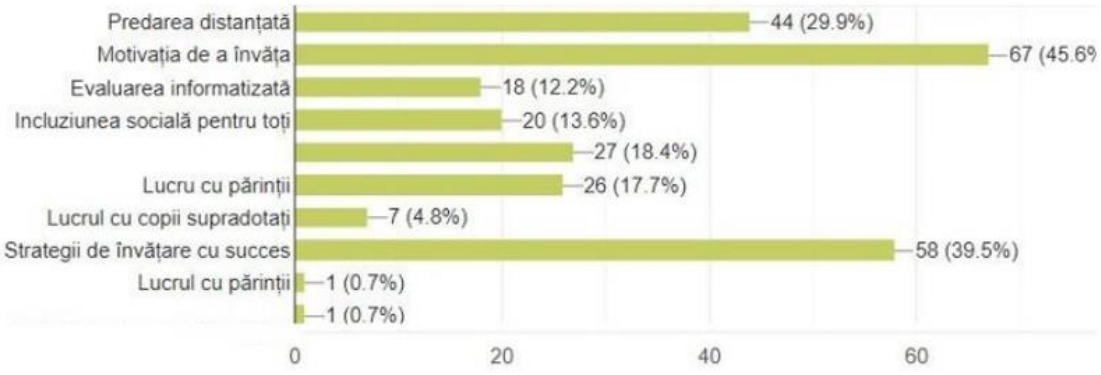


Figure 2.16. Interest in the psycho-pedagogical theme of continuing education courses

The term "remote teaching ", also defined as "remote learning " is a consequence of the COVID-19 pandemic. However, although teaching, learning, and evaluation cannot be separated from the specifics of remote learning in the global conditions of maximum uncertainty and the suggestions of specialists, such as: ensuring fairness, clearly communicating expectations, offering learning models centered on the learner, the use of high-quality free resources, ensuring emotional balance [68] it is observed that the teachers attending the continuous training courses are interested in topics from pedagogy, psychopedagogy, sociology, and educational management.

2.3. MANAGING METACOGNITION AND SUCCESSFUL LEARNING STRATEGIES

2.3.1. The specifics of metacognition and successful learning strategies

In the management of global education theory and technology, global problems of teaching, learning, and assessment can be solved not only through cognitive strategies. According to John H. Flavell, there are situations in which reflection on what we learn, how we learn, and what conclusions we have drawn from a particular experience is important. For this purpose, it is important to have metacognitive knowledge and metacognitive experiences [69]. The hypothesis from which we start the study of experiences is: metacognition has the same epistemological and praxiological value at the pre-university and university levels.

The main results obtained at the scientific management stage of the work are:

- metacognition is an important epistemological and ontological construct for adapting to the diversity of learning environments;
- metacognitive strategies are the prototype of critical thinking and creativity;
- metacognitive strategies can be planned, learned, and evaluated.

Metacognitive knowledge and experiences are the direct results of metacognitive strategies. Such strategies represent the meta-sum (where meta refers to more than..., beyond...) of metacognitive knowledge and experiences because the final effect is greater, compared to the sum of the constituent elements. This idea was promoted in the paper [70]. Based on the analysis of the scientific literature, it is initially observed that most researchers pay more attention to the study of the strategic variables of metacognition (Heyes (2016), de Bruijn-Smolders et al (2016), Berger et al (2016), Herrmann et al (2016), Barzilai et al. (2016), etc.). The arguments of these scholars are as follows:

- metacognitive strategies cannot be separated from time, effort, and learning management;
- metacognitive strategies can be taught and learned through mnemonic techniques;
- there is a close connection between identity, confidence, and academic achievement.

The conceptual framework of the work capitalizes on the learning situation in which there should be a strategic plan of action between the strategy of the pedagogue and the tactics of the learner, the implementation of which would lead to a synergistic effect. Two situations are possible:

1. *Ideal case:* strategy and tactics form a tandem (educational activity carried out based on the common goal with active, interactive, transformative learning activities, evaluated by the teacher).
2. *Real case*: strategy and tactics do not form a tandem and various stratagems appear in the learning environment.

In cybernetics, strategy represents the process of successful and continuous decision-making actions. According to game theory, strategy can be divided into strategic situations represented by an adjacency matrix. For example, in strategic situation x the teacher imparts knowledge and the pupil/student learns. Several solutions are possible for such a situation, the simplest being the self-teaching situation (teacher A or learner B). This situation can be described by a matrix with the following elements, *a, b, c. d*:

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \quad B = \begin{pmatrix} e & f \\ g & h \end{pmatrix}$$

where *a, e* – the purpose (pedagogical, didactic, personalized, etc.)

b, f – instructional, operational, learning, evaluation, etc. objectives.

c, g – competences (knowledge, skills, attitudes, including metacognitive knowledge/experiences)

d, h –organization form of the educational process (resources, tools, technologies, etc.).

In the organization form of the didactic tandem process " strategy $\rightarrow$tactics", the teacher plans the learning strategies, and the pupil/student learns them, by applying knowledge and metacognitive experiences. This situation corresponds to the mixed strategy model that values the decision-making and behavioral actions of both actors in the educational process. Therefore, in the case of the mixed strategy, the educational activities are designed and coordinated by the teacher with the more or less active involvement of the learner and, respectively, can be described as follows:

$$A + B = \begin{pmatrix} a & b \\ c & d \end{pmatrix} + \begin{pmatrix} e & f \\ g & h \end{pmatrix} = \begin{pmatrix} a+e & b+f \\ c+g & d+h \end{pmatrix}$$

Such a situation also corresponds to mentoring activities, if these activities include goal-oriented (meta)cognitive processes to help the learner to be aware of the depth of academic concerns and barriers to success, as well as the management of time, space, and information. An important aspect relates to strategic thinking, problem-solving, collaborative learning, and group assessment. Often, the strategic tandem does not lead to valid results demonstrated throughout life, although it has been conceptualized as guaranteed educational ends:

$$A - B = \begin{pmatrix} a & b \\ c & d \end{pmatrix} - \begin{pmatrix} e & f \\ g & h \end{pmatrix} = \begin{pmatrix} a-e & b-f \\ c-g & d-h \end{pmatrix}$$

There is no statistical data that would confirm that the best students are also the most successful in life. From the perspective of metasystem thinking, the likelihood of success increases if learning strategies and tactics can be experienced in a diversity of learning environments. In our opinion, successful learning strategies are a set of generalized complex numbers:

$$z = x + iy \; (x, y \in R) \quad where \quad i^2 = iq + p \; (q, p \in R)$$

where *z* is one of the three complex numbers that can be assigned to the macrostructure of the competence (knowledge, skills, attitudes). Thus, it is observed that the only solution is to complement

the strategy designed by the teacher with the metacognitive tactics of the learner. Such a situation can be modeled at the level of the educational organization as "organizational strategy" (Ibidem, p.10), the essence of which consists in the design, elaboration, and implementation of educational activities arising from the specificity of the uncertainty of conscious actions in the diversity of learning environments and, respectively, the learning needs of the learner.

2.3.2. Management of metacognitive strategies

Learning strategies are classified into cognitive strategies, social/affective strategies, and metacognitive strategies [71]. The weakest one in this list is metacognitive strategies because it is not clear what metacognitive strategies are and how metacognitive strategies are managed. Examples of metacognitive strategies are: identifying learning style and need; how to design, perform and monitor tasks; assessing learning success, etc.

The monograph [72] describes the conceptual and praxiological approaches to the management of (meta)cognitive strategies; performance architecture in a metasystem approach; the interdependence between types of cognition/metacognition and learning environments; metamemory; comprehension; the problem of classifying metacognitive strategies; the role, place, and importance of control in metacognitive strategies, critical thinking, motivation and creativity in the management of metacognitive strategies, etc.

From the outset, it is noted that educational managers' reasons for setting the mission, purpose, or goals of the educational organization are strongly influenced by societal challenges, and accordingly, they may often be left with the residual task of prioritizing global imperatives (e.g., emerging educational technologies) disregarding the real needs of learners and teachers. As a result, the institution's educational strategy and educational management model do not correspond to reality.

Metacognitive strategies are provided by the capacity/processes of planning, monitoring, and control of the learner. Such strategies are recommended in situations where "educates have the ability to identify the best way to solve a problem situation or are motivated to develop these capacities" (Ibidem, p. 22). Cognitive strategies differ from metacognitive ones by their functions and structural elements, but they are performed simultaneously and, respectively, together provide deep knowledge. For example, in a situation where an algorithmic problem-solving process is used, metacognitive strategies seek answers to the questions: *What do I know about the conditions/data of the problem? What do I have to do? What do I need to know? How do I monitor the process/action/activity? How do you evaluate the activity/solution obtained? How do I appreciate the situation created? and so on.*

The complex structure of metacognitive strategies, which belong to metacognitive knowledge and experiences, is made up of planning strategies, monitoring strategies, and evaluation strategies, but the structure of each constituent remains a problem with many unknowns. On the one hand,

metacognitive strategies cannot be realized without metacognitive knowledge/experiences, on the one hand, and on the other hand – digital technologies have become quite intelligent for the external realization of these strategies. The management of metacognitive strategies cannot be carried out unequivocally from the perspective of the teacher without the active involvement of the learner. Respectively, the concept of regulating metacognition through planning, monitoring, and control skills on the part of the teacher, described by Livingston (2003) [73] is not metasystem if it is not complemented with the tools of learning analytics.

From the perspective of the theory of metasystem design of learning, "metasystem thinking is a type of critical thinking, the specificity of which consists in the non-linear expansion of the idea in several directions by leaving the comfort zone and identifying the visible in the invisible to identify the most realistic solution" (Ibidem, p.35). In this situation, it is important to take into account the specifics of the learning environment. On the one hand, the digital world is becoming more inclusive, adaptive, and permissive for self-learning and self-assessment. On the other hand, the interconnection between perception, information systems, data, digital tools, and things is ensured by the Internet. "The digital environment also offers other opportunities that must be explored at the level of interest and curiosity of the learner" (Ibidem, p.41). The understanding of these new forms of (meta)cognitive nature would allow the identification, exploration, and dissemination of adaptive learning strategies.

The three-dimensionality of the competence structure was described by Minder (2003). In our opinion, the savoir conceptual model, realized in a topographical plan, describes the structure of the key competences. Thus, knowledge, including metacognitive knowledge and experiences, fall into the savoir-dire dimension (corresponds to theoretical and verbal knowledge), skills – into the savoir-faire dimension (include learning strategies, methods, procedures, and techniques, including metacognitive strategies), and attitudes - in the savoir - etre dimension (refers to the will, affectivity, emotions, motives, motivations, etc.). Hypothetically, the integration of dimensions ensures lifelong learning (Fig. 3.17).

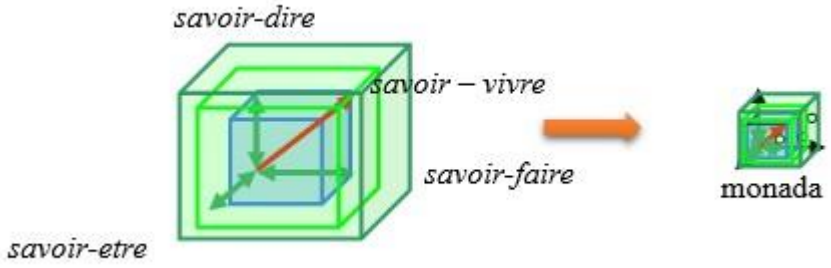


Figure 3.17. The "savoir-vivre" form of competence and the monad

The quality of savoir-vivre in the monad depends on the reliability of the learning management, including the managerial expertise one possesses (expert (situation A) or novice (situation B)), the perception of the learning situation, and the ability to design, realize, monitor,

evaluate and appreciate individually or/and in a group the cognitive, social/affective and metacognitive activities in a diversity of learning environments (Fig. 3.18).

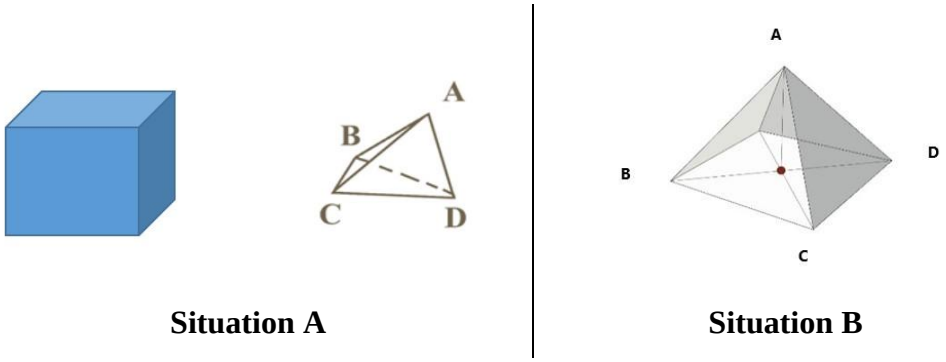


Figure 3.18. The distinction between the teacher's and learner's perception of the learning situation

Digital technologies have radically changed teaching, learning, and assessment strategies and methods. At the current stage, with the help of technologies, the learner can position himself inside (situation C) or outside the learning object (situation D) to obtain situational data or fragments in the form of images, from which knowledge of the learning object can be obtained (Fig 3.19).

Figure 3.19. Investigating the learning object with smart technologies

An additional underexplored situation is a virtual reality – an educational technology that is believed to enable learning through the safe exploration of learning objects. However, taking into account that the human brain perceives modeled experiences as similar to real ones, it is important to understand the sustainability of performance in real-virtual learning environments. The problem data are as follows. On the one hand, metacognitive knowledge is found in Bloom and Krathwohl's updated Taxonomy as strategic knowledge; knowledge about cognitive tasks, including contextual and conditional knowledge; self-knowledge. Metacognitive experiences, on the other hand, are conceived as regulated by the teacher. Metacognition management is a problem with many unknowns.

In general terms, the management of metacognitive strategies in real-virtual learning environments is a complex and multifaceted problem. At the current stage, the problem is becoming more acute due to the multiple attempts at a unilateral solution (cybernetic or neuroscientific

perspective). Thus, there is an increasing number of intelligent machines, robots, and learning environments, but at the same time a large number of researches in the field of types of knowledge (eg embodied cognition, situated knowledge, etc.). The solution to this problem is focused on the following assumptions:

- metacognition represents the basis of effective learning and communication, including meta-memorization, meta-comprehension, and meta-analysis;
- metacognitive decisions are based on judgment, if there is an "object level" that ensures the connection between cognition and metacognition;
- comprehension describes the ability to judge and/or appreciate knowledge;
- formative assessment, control, and metacognitive monitoring are forms of knowing.

According to recent research, metacognitive strategies can be considered the result of the orientation of cognitive strategies toward planning, monitoring, and control activities. These strategies are called (meta)cognitive. Examples of (meta)cognitive strategies are a) vocabulary formation/development strategies; b) strategies for training / developing academic writing skills, etc. A special role in the management of metacognitive strategies belongs to creativity, collaborative activities, and critical thinking.

2.3.3. Management of metacognitive strategies at the pre-university level of study

Metacognitive strategies are formed and developed over time throughout life. The management of metacognitive strategies at the pre-university and university stages has some distinctive features. The paper [74]] aims to analyze research in the management of metacognitive strategies in pre-university education. Research data was extracted from the online environment and graphed with Google Books Ngram Viewer. Initially, the time limits 1950 - present was fixed, and three terms were selected: cognition, metacognition, and educational management translated into English.

The results of the investigation are as follows:

1) Concerning cognition and educational management, metacognition is less studied; the peak of the study of cognition is observed in the eighties (Fig. 3.20).

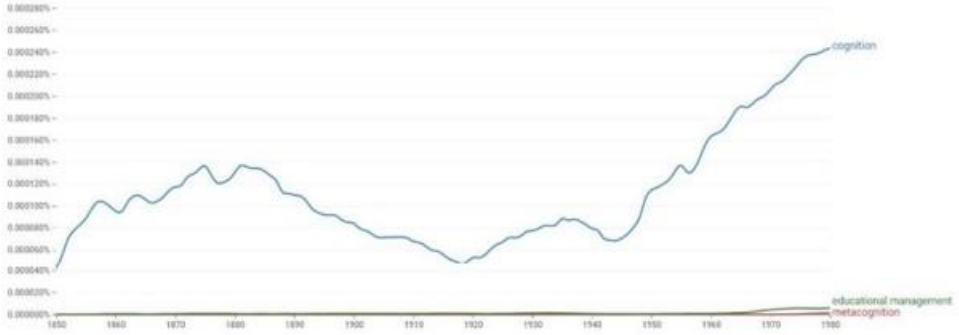


Figure 3.20. Dynamics of "cognition", "metacognition" and "educational management"

Fixing the parameters "educational management" and "metacognition" in the period 1950-1980 allows us to observe the emergence of studies in metacognition. The "leap" in scientific research of educational management compared to studies in metacognition can be explained by the metasystem transition from the model of scientific management to the model of informational management, proven by the implementation of knowledge management systems in educational organizations (Fig. 3.21).

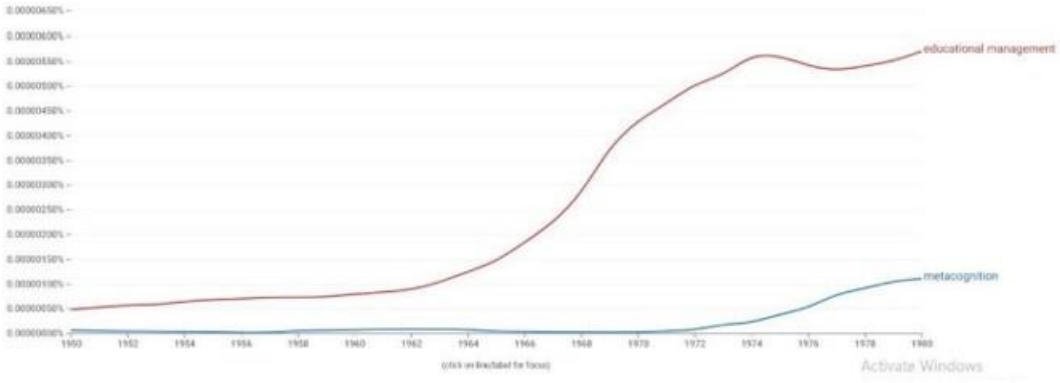


Figure 3.21. The emergence of research on metacognition

The analysis of scientific research from 1981 to the present infers the "reversal" of interest toward the understanding of metacognition compared to the topic of educational management. Estimated, this result demonstrates the applicability of artificial intelligence in learning environments (Fig. 3.22).

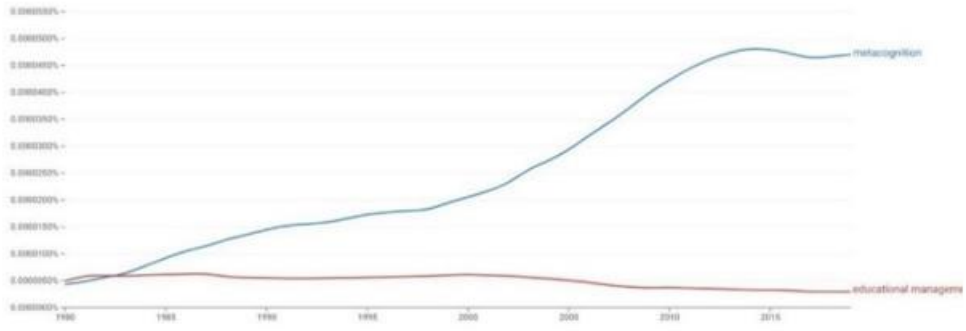


Figure 3.22. The "reversal" of scientific interest from cognition to metacognition

The detailed analysis of the reversal of scientific concerns in educational management compared to metacognition allows us to conclude: a) preschoolers possess verbal and non-verbal metacognitive capabilities and behaviors, including the regulation of cognitive, emotional, and affective states; b) there is a strong correlation between language skills and metamemory; c) perfecting metacognitive experiences is the condition for acquiring more effective strategies for knowing one's capacity.

In preschool, the effect of performance feedback is monitoring the accuracy of predictive judgments. Recent research by Urban and Urban (2021) [75] demonstrated that success related to the achieved performance is an important condition for future achievements, but not an indication to design a new set of tasks. The external cue is an important motivational factor. Therefore, feedback-sensitive preschoolers are also sensitive to the anchoring effect of feedback in metacognitive knowledge and experiences. Metacognitive knowledge is the sum of intellectual, emotional, and social factors.

At the school stage, the first educational programs for the formation of (meta)cognitive strategies can be designed, developed, and realized. The need for such programs derives from the importance of increasing the level of metacognitive awareness; positive attitudes toward the study of sciences, mathematics, and technologies; developing the capacity for self-instruction, self-assessment, and lifelong learning. An important role belongs to formative evaluation.

A special role in the management of metacognitive strategies belongs to the design, realization, and monitoring of argumentation schemes of the reflexive capacity. These epistemological and ontological constructions, which depend on the form and content of successful learning strategies, can be integrated into the digital portfolio in the form of a set of questions for each type of reasoning (according to the study of Cappellaro and Seban, 2021) [76]. The condition is that the nature of the dialogue between teacher and student is rigorously designed with the identification of the characteristics of the premises or the relationship between premises and consequences.

The management of metacognitive strategies at the school stage also includes the first attempts to design, develop and implement learning strategies, including self-instruction, self-assessment, and effective time management. If the management of metacognitive strategies is not done correctly, there is a danger of forming tactics that, though including "intelligent" purpose and form, have no viable content. We conclude that at the pre-university level, the management of metacognitive strategies is a determined goal, but it depends on the conditions and opportunities of the learning environment in which the management model is constituted. If risks are minimized, form is obtained, but not content.

There is a direct correlation between cognition, metacognition, and successful learning strategies. The management of successful learning strategies at the preschool level can be considered a transdisciplinary research area at the frontier among cognition, metacognition, and appreciative intelligence involving metasystem delineations in philosophy, psychology, sociology, pedagogy, cybernetics, and management. Investigating this assumption could result in updated norms of educational management.

2.3.4. Managing the learning to learn competence at the university level

The problem pointed out by us consists in the fact that "metacognition has several facets, a fact that makes it difficult to distinguish between monitoring processes and control processes and their impact on the quality of learning" [77]. If we take into account the European competence framework, students should demonstrate eight key competences, one of which is the competence to learn. In reality, most students are not motivated to learn.

What is the specificity of the learning to learn competence at the university level? In the scientific work [78], carried out with the metasystem methodology, the transition from the European educational policy documents developed from 2008 to 2018 is observed. Based on the observation and taking into account the theory of the metasystem design of learning, it is noted that the learning-to-learn competence, one of the eight key competences of the European framework, with a meta- "transition" into the personal, social, and learning-to-learn competence. The new conceptualization refers to "the ability of the learner to reflect on himself, manage time and information effectively, constructively work with others, remain resilient, and manage his learning and career" [79]. But the specificity of higher education consists in "training professional competence" [80].

The main results of management's research in the area of learning to learn competence are:

1) The paper presents similarities and differences in the conceptualization of the structure of key competencies. Skills include higher-order thinking abilities (skills, abilities, intelligence, etc.), including those focused on metacognitive knowledge and experiences; attitude reflects disposition, motivation, beliefs, etc. (Table 3.4):

Table 3.4. Similarities and differences between knowledge, skills, and attitudes

<table>
<tr><th></th><th>Consiliul Europei, 2006</th><th>Consiliul Europei, 2018</th></tr>
<tr><td>Asemănare</td><td colspan="2">aspectele cognitive, afective și motivaționale</td></tr>
<tr><td>Cunoștințe</td><td rowspan="3">Competențele reprezintă o combinație de cunoștințe, abilități și atitudini adecvate contextului. Competențele-cheie sunt acelea de care toți indivizii au nevoie pentru împlinirea și dezvoltarea personală, cetățenie activă, incluziune socială și angajare.</td><td>fapte și cifre, concepte, idei și teorii care sunt deja stabilite și susțin înțelegerea unui anumit domeniu sau subiect</td></tr>
<tr><td>Aptitudini</td><td>abilitatea și capacitatea de a efectua procese și de a utiliza cunoștințele existente pentru a obține rezultate</td></tr>
<tr><td>Atitudini</td><td>dispoziția și mentalitățile de a acționa sau a reacționa la idei, persoane sau situații</td></tr>
</table>

2) Competence has an "observable form" (knowledge and skills (which corresponds to savoir-dire and savoir-faire)) and an "invisible form" (values, beliefs, motivations, attitudes, etc. (corresponds to the savoir-être side)). Training/development of professional skills at the initial stage can be monitored by the teacher (through formative assessment,

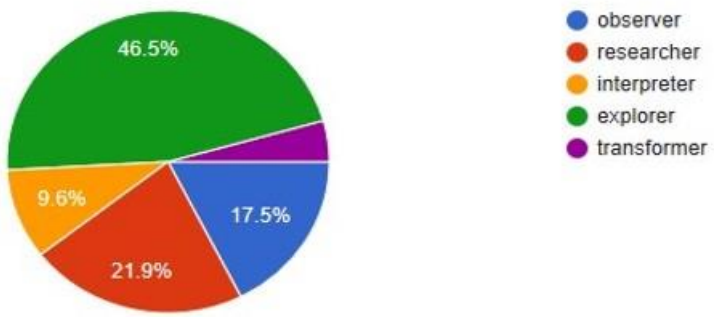
guidance, mentoring, etc.) and/or by the student (through metacognitive strategies, self-control, self-testing, etc.), including digital technologies.

3) The savoir-vivre model of competence reflects the genotype (energetic-action potential of the learner) and the phenotype (psychic and behavioral actions and therefore depends on the way each human individual perceives and responds to environmental stimuli and conditions.
4) The professional side of the key competences can be constituted based on strategies, methods, procedures, learning techniques, etc. Professionalism also depends on the ability of the individual.
5) At the stage of undergraduate courses, the management of professional competence constitutes a situational tandem between the teacher's strategy and the student's tactics, which can be achieved, in a diversity of learning environments (teacher-centered and/or learner-centered), if they are designed and realized based on the dynamic and flexible instructional strategy.

One of the most important issues in the development of personal, social, and learning-to-learn competence is the investigation of the factors and conditions that contribute to intrinsic motivation.

The article [81] presented at the XIV international conference in management science and engineering, aims to investigate intrinsic motivation in a diversity of learning environments. The result of investigating the topic of intrinsic motivation is presented in the conceptual framework of the paper. The research method consists in developing an online questionnaire based on the questions extracted from the conceptual framework. To the questions, 141 respondents physically located in the Republic of Moldova and Estonia answered the online questionnaire. The most important results obtained are the following:

What makes the educable to explore the new learning environment? The formation of the human being by the global society is not mainly achieved due to the impact of social factors or global problems. Today's learner is, first and foremost, an explorer, and then an observer of the new that captures his attention. He/she is guided by the motivation to make a certain effort ((meta)cognitive, affective, etc.) (Fig. 3.23).



This result raises serious questions about the theory and technology management of global education, such as the impact of digital technologies on social perception and decision-making; the specificity of management, and the importance of accepting metacognitive strategies.

What is the motivation to explore new environments? More often than not, new learning environments are unfamiliar or little known, but at the same time, they offer a multitude of stimuli that increase interest and curiosity. According to respondents' answers, intrinsic motivation is primarily determined by the attraction to explore new cultures and, respectively, identify new learning objects, and all of these can be present in digital format (Fig. 3.24).

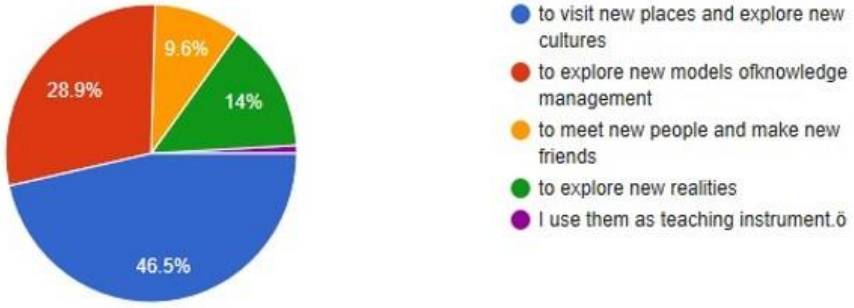


Figure 3.24. The outcome of the study of motivation in a diversity of learning environments

In the school educational environment, intrinsic motivation depends on the relationship between the learner and the purpose of the teacher. But if the learning processes occur in a diversity of learning environments, then the management of self-regulated learning is important. In this case, intrinsic motivation is determined by stimuli that ensure personal advancement (31.6%) through leadership (Fig. 3.25).

Figure 3.25. Maintenance of the hierarchy of human needs

What does motivation depend on in diverse learning environments? In the school educational environment, motivation depends on the relationship between the learner and the instructional objectives designed by the teacher. But if the learning processes occur in a diversity of learning environments, then the management of self-regulated learning is important. In this case, intrinsic motivation is determined by stimuli that ensure personal advancement (31.6%) through leadership (Fig. 3.25).

Figure 3.25. Maintenance of the hierarchy of human needs

A broader understanding of the concept of intrinsic motivation comes from the specifics of human actions and activity in a diversity of learning environments. However, the respondents' opinions differ: the majority of respondents state that in a diversity of learning environments, the learner is fully involved in the learning process and has full control over the finality of the learning (36%). A smaller number of respondents agree with the idea that the learning process is based on the confrontation of the learner with practical, social, or personal problems (32.5%), and 30.7% highlight the importance of self-evaluation as a measurement method of the progress of lifelong learning management (see Fig. 3.26).

Figure 3.26. Motivation is a personalized construct of motive, energy, and intellect

In sum, we can state that the issue of intrinsic motivation is specific and, to a large extent, determined by the interest, motive, and curiosity of the learner. For these reasons, it is important to relate the concept of motivation to a stimulus in the environment, whether real or virtual, that captures the learner's attention and increases interest in exploring phenomena, processes, or learning objects. In other words, learners do not have a universally accepted or socially determined intrinsic motivation. Motivation is a complex (meta)cognitive-affective construct, "coordinated" by the learner toward solving specific problems or tasks. Understanding the factors that determine or inhibit intrinsic motivation remains a problem.

2.4. MANAGEMENT OF ECOSYSTEM MODELS OF LEARNING AND COMMUNICATION IN THE GLOBAL EDUCATIONAL ENVIRONMENT

2.4.1. The problem of sustainability of learning in global education

The global educational environment, made up of a diversity of learning environments, is ecosystemic. In general terms, the term "ecosystem" (also called e-learning ecology, digital ecosystem, or learning ecosystem) means the set of elements necessary to ensure the e-learning solution. An ecosystem model of e-learning consists of infrastructure, content providers, consultants, and learners. The purpose of the human-designed ecosystem is to disseminate resources for people. Thus, an "ecosystem model" describes an abstract representation of an ecological system to facilitate the understanding of the mechanisms and/or processes that occur in a real educational ecosystem.

We believe that at the current stage in the ecology of knowledge, the "man-things-learning object" interaction realized in or through the global educational environment (digital environment) is valued, and in education for sustainable development - the conservation of natural resources. Such inconsistency can be removed by designing an ecosystem model of learning and communication. To achieve this aim, it is important to identify the balance point between classical theories of learning (based on the laws of behaviorism in the formal educational environment) and non-classical theories of learning and communication (influenced by the impact of external factors on the ability to learn in a diversity of lifelong learning environments).

The scientific coordination of the volume "Handbook of research on ecosystem-based theoretical models of learning and communication" aimed to classify ecosystem models, studied in a diversity of learning environments. Teachers from the United States of America, Italy, Romania, Russia, England, and India participated in the achievement of the goal. The meta-analysis of the papers led to the following result, exemplified by the title of four parts of the volume. Ecosystem models of learning and communication can therefore be classified into four categories:

- theoretical ecosystem models;
- ecosystem models for e-learning;
- ecosystem models of social partnership;
- ecosystem models of signs, language, and intercultural communication.

It is obvious that such a categorization, carried out following the metasystem methodology, is not equivalent to the result of the systemic analysis, according to which we distinguish: the ecosystem of business, innovations, entrepreneurship, and knowledge [82]. What we can observe, however, is that the theme of anthropocentric ecosystem models is active, accompanied by the constant (re)conceptualization of instructional design models and the amplification of the practical value that these models have for educational sustainability and the design of learning environments.

In an ideal ecosystem of learning and communication at the forefront is the ability to learn in a diversity of environments and its maintenance throughout life. For these reasons, in the ecosystem, performance is considered more important, compared to competence. However, the specific attributes of each hierarchical type of ecosystem in the range of educational ecosystems already developed, as well as the "contribution" of each ecosystem to the sustainability of education in the global ecosystem, are unclear. On the one hand, we are witnessing the so-called post-digital or post-pandemic period, in which teachers and students have become accustomed to digitized content and tasks, but also digital screens; on the other hand, the design of ecosystem models focuses on the humanization of learning content management systems.

2.4.2. The specifics of learning and communication in knowledge ecosystems

Chapter [83] capitalizes on the specifics of learning and communication in educational ecosystems. In the conceptual part of the work, it is stated that humanity is at the stage of advanced anthropocentrism, which is characterized not only by the irreversible impact of human activities on the climate and environment but also by the natural mechanism of learning and communication. These ideas are proven by data that at the beginning of the millennium 8.4 billion digital screens connected 7.6 billion people to the digital environment. Therefore, human beings are irreversibly attracted to the stimuli of the digital environment, and this facilitates learning and communication in a different way than the traditional one.

Any natural ecosystem is ensured by environmental conditions (light, temperature, water quality, amount of oxygen, etc.). However, if we were to compare at least two conceptualizations of the learning and communication ecosystem: a) "cooperative educational ecosystem" [84] and b) "an ecosystem is an object that could be studied directly, using conventional scientific methods" [85], we can affirm: in the conditions of the diversification of learning environments, the impact of the environment on the quality of education and intrinsic motivation is particularly acute. The problem derives from the dilemmas: a) each ecosystem element has its niche or collaborates for a common goal; b) the order of the ecosystem is ensured by the heterogeneity of the constituent elements or by setting the instructional objectives the homogenization of performances occurs; c) knowledge systems are unpredictable and uncontrollable or everything is energy, information, and feedback (Ibidem, p. 3).

The transition from school educational management models to the holistic model, called data-based leadership, offers global opportunities for learning and communication in/through the digital environment, but also global risks of designing and developing ineffective educational resources. The term "global risks" refers to the scaling of the phenomenon of global education in the real-virtual environment in the form of a) global crises (digital, cognitive) or critical situations (cyber insecurity, digital hygiene, mental disorders, attention deficits, etc.). "Global risks affect the ability to learn and

communicate" (Ibidem, p. 9). The study of risk management in the educational activity carried out in a diversity of learning environments constitutes a global problem in educational theory and management.

The definition of the learning and communication ecosystem was obtained by comparing the characteristics of the traditional ecosystem (community in which each element has its niche, and order resides in heterogeneity) with those of knowledge management systems. In our opinion, "the ecosystem of learning and communication constitutes a metasystem in which the ability to learn throughout life and communicate in a diversity of interdependent and interrelational learning environments is a priority" (Ibidem, p. 12). At the heart of the learning and communication ecosystem is the human being, including the capacity and competences at his disposal, as well as the "adaptation" to management models. Often, to reduce the impact of societal challenges, "innovative solutions" are sought. E.g,

- informational overload → reduced learning motivation;
- extended time working at the computer → superficial learning;
- outdated classroom space → new environments / personalized learning spaces;
- irrelevant content in the school textbook → open educational resources, etc.

The listed examples point out the importance of complying with ergonomic norms in the design of a learning and communication ecosystem, which would ensure society's need for qualified labor, but at the same time would take into account the need to learn for personal development. In our opinion, at the current stage, the educational ecosystem represents "a mix of natural ecosystems and software ecosystems (technological, digital)" (Ibidem, p.12). The natural ecosystem is made up of all the biotic/abiotic elements and processes specific to the habitat environment, and the software ecosystem - of the elements and processes that occur in computer systems. Therefore, the study and understanding of the mechanisms and processes in the transition from the formal educational system to the "natural ecosystem - software ecosystem" correlation is important for the sustainability of education.

2.4.3. The issue of soft power in educational leadership

The dynamic balance in the learning and communication ecosystem is ensured by the quality of leadership. In identifying the leadership model specific to educational management in a diversity of learning environments, it is important to understand that the behavior of leaders in an educational organization reflects a kind of power that manifests itself through the leader's ability to influence others and/or the way to remove obstacles to achieve a goal, determined by the desire to lead.

In leadership theory, the concept of power is characterized based on three categories: hard power, and soft power, also called smart power [86]. In our opinion, hard power can be associated with the quality of one's example; blind power – with the ability to argue and convince, and smart power –which changes beliefs.

The article [87] aims to investigate the issue of soft power in educational leadership. It is observed that, with the diversification of learning environments during the pandemic period, soft power was achieved through digital technologies, which allowed the rapid transition from the school educational environment to a diversity of learning environments. As a result, a different culture of teaching, learning, and assessment has been established in the post-pandemic stage, also called "a new normal". This new global culture is driven by the fact that pupils/students have become accustomed to teaching, learning, and communicating in/through the digital environment, and teachers can no longer teach without using the digital screen. At the same time, this educational situation is accompanied by psychopedagogical and managerial conflicts.

The methodology of the paper is focused on the study of global trends in the investigation of soft power, educational leadership, and conflict management. For this purpose, the scanning of articles published in Google Scholar from 1960 to the present and the graphical representation with Google Books Ngram Viewer were performed. The obtained result demonstrates the prevalence of the global tendency to study soft power (Fig. 4.27).

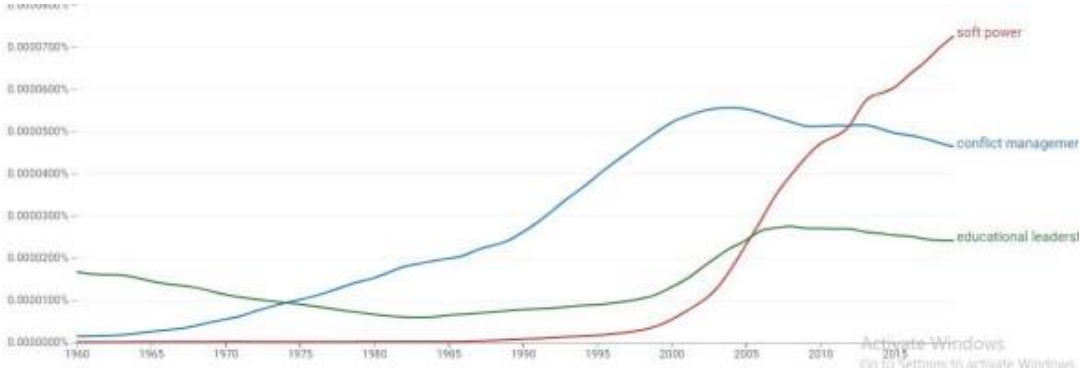


Figure 4.27. Trends in the study of soft power, conflict management, and leadership

Based on this representation, it is concluded that soft power is a current research topic, including in educational management. This theme is studied by investigating several scientific problems, among which stand out: a) the problem of understanding the ecosystemic nature of conflict management in the situation of rapid diversification of learning environments, the emergence of new ways of teaching-assessment and alternative methods of learning and communication and b) the problem of identifying the educational leadership model with the specifics of power in a diversity of learning environments.

Conflict management is a problem of educational management and leadership, determined by the impact of global factors (e. g. digitalization, cognitization, etc.), situational factors (e.g. inter-organizational, interpersonal conflict, etc.), and internal factors (e.g. interest, curiosity, motivation) on the perception and decision-making capacity of the educational leader. Soft power becomes a characteristic of educational management ensured by the interrelational nature of learning environments which represent an ecosystem model of learning and communication, in which each has a unique predetermined role.

The elucidated problems can be studied if the epistemological and methodological benchmarks of open pedagogy are known. The term "open pedagogy", synonymous with "open educational practice", describes the use of open educational resources in the global educational environment. The problem derives from the contradiction: a) open pedagogy aligns with the development phase of Internet technologies or b) the open educational environment is ecosystemic and, respectively, integrates human-computer and computer-computer interaction models, and the applicability of these models depends on the level of awareness of the interrelationship between man, learning objects, society and the management of these interactions.

2.4.4. The issue of plagiarism, licensing, and appropriate use of digital textbooks

An important issue in the management of ecosystem models of learning and communication concerns plagiarism, licensing, and the appropriate use of digital textbooks in the global educational environment. In the article [88] the essence of plagiarism is studied from the perspective of global trends, thus identifying two directions: a) presenting someone else's work as one's work; copying texts, or ideas from someone else without giving references; not placing a quote in quotation marks, providing incorrect information about the source or quote; changing words but copying the sentence structure of a source without giving credit; copying so many words or ideas from a source that it constitutes the majority of your work, whether or not you give credit (plagiarism.org), and b) “copying or paraphrasing the work or ideas of others without full acknowledgment” (University of Oxford, 2014). The types of plagiarism were identified by analyzing the anti-plagiarism policies of the universities of Pittsburgh, Cambridge, and Harvard.

The case study concerns the open manual developed under the open license. The identification of this issue allowed to state that the open license positions the open textbook away from the digital textbook, offering those interested the opportunity to read, print, and download the content of the digital textbook, but also to elaborate and/or customize it based on a pedagogical strategy or instructional. In both cases, it is important to respect the commitments of the open license. The problem of the study is described as a transition of the "plagiarism, copyright and licensing" metasystem. This way allowed to identify inconsistencies between the technical recommendations to avoid plagiarism (e.g: paraphrasing), the provisions of the open license (eg: remixing, transformation, reconstruction), as well as the ability of the user to critically analyze and evaluate the performance of to use open educational resources.

2.5. MANAGEMENT OF ASSESSMENT STRATEGIES

2.5.1. The issue of management of assessment, measurement, and appreciation strategies

A specific issue of global education theory and technology management is evaluation. The problem derives from the permissiveness of the digital environment to design, elaborate, and appreciatively evaluate the mechanisms, processes, and outcomes of learning and communication through data. The digital environment has diversified the forms of evaluation through various (meta)cognitive strategies that can be delimited into three global trends:

- *learning assessment* – strategies and methods aimed at a) confirming what was learned (what is known at the time of the assessment); b) demonstrating whether the curricular objectives have been achieved or c) certifying the performance, competence or skills obtained;
- *assessment for learning* – approach to teaching and learning in which the feedback provided is the foundation to improve the performance of the learners;
- *assessment as learning* – strategies determined by the performance of the teacher and/or learners to monitor and reflect on the quality and motivation of learning.

Chapter [89] summarizes the current global trends in the study of assessment, measurement, and testing strategies in higher education. The results obtained are presented in Table 5.5.

Table 5.5. Global trends in the study of assessment, measurement, and testing strategies

N	The name	The topic studied
1	Student-centered university strategies	Pedagogy of new university assessment strategies Digital assessment methods versus traditional assessment methods Flipped learning strategy with double peer review E-portfolio and Open Badges for learning outcomes Assessment activities strategy for deep learning
2	Practical activities and strategies for successful assessment	Formative assessment and appreciative intelligence Evaluation methods in metacognition and critical thinking Digital assessment techniques of higher-order skills The importance of spiritual intelligence in assessment The assessment strategy for learning rhetorical competence
3	Assessment as/for learning	Modern strategies for evaluating the skills of future specialists The entrepreneurial skills assessment model Authentic assessment as a tool for strengthening skills
4	Digital assessment	The computerized technology of the modular model of pedagogical monitoring Digital assessment and the role of neuroscience in assessment theory and technology

2.5.2. Learning management from the perspective of assessment strategies

In classical pedagogy, school evaluation is defined as a process of comparing the instructional-educational results with the planned objectives and the resources used. However, if we take into account that the assessment represents strategies for assessing the learner's performance in adapting to the uncertainty of the environment and the diversity of learning environments, the emergence of several research questions can be observed:

- What is the impact of assessment strategies on the maintenance of lifelong learning?
- What is the current specificity of management theory and evaluation technology?;
- What is the socioeconomic impact of a university assessment on global society, from the perspective of skilled workforce training? and so on.

In chapter [90] the theory of learning and educational purposes are studied from the perspective of the management of assessment, measurement, and testing strategies in higher education. From the start, it is observed that "students adopt global, strategic tactics and search for clues regarding specialization and prefer to obtain diplomas and certificates at an internationally recognized level" (Ibidem, p. 3).

Evaluation is the activity of evaluating something or someone based on predetermined criteria. The motivation of evaluation and self-evaluation in the diversity of learning environments is additional evidence of the fact that students are active, responsible, autonomous, interested in everything new, and can bring added value to the educational activities carried out in the global educational environment. This process involves not only cognitive strategies but also metacognitive ones, considering that it includes reflections on knowledge and knowledge acquisition experiences, including metacognitive design, evaluation, and monitoring strategies. Therefore, assessment in all its forms is a result of metacognition, knowledge of successful learning strategies, and their management.

The methodology of the paper is based on the analysis of the contradictions between the classical and non-classical theory of evaluation from a metasystem perspective. Based on this methodology, the following contradictions were identified: the degradation of knowledge versus large-scale international educational assessment; "evaluation and dialogue" versus external control; assessment, study space, and learning spaces versus computer-assisted assessment. The study of these controversies is initiated by investigating the following philosophical questions: What is the global phenomenon of knowledge degradation? What are the results of the large-scale evaluation? Evaluation, dialogue ... or control? Evaluation and modularization? Assessment and learning time? Assessment and learning space? Traditional and/or digital assessment?

2.5.3. Quality management of digital assessment strategies

The post-COVID-19 period has marked a new era in the management of global education theory and technology. The pandemic accelerated the adoption of computerized assessment strategies in the real-digital environment, but also the need to assess their quality.

The article [91] aims to sensitize public opinion regarding the importance of investigating the quality management of evaluation strategies to the needs of the individual and society. The questionnaire includes 13 items grouped into five reflection questions:

- What are the most popular digital tools for creating computerized tests?
- What are the best-known computerized assessment strategies?
- What is the most important difference between computerized assessment and traditional assessment?
- What is the role of the didactic design of computerized assessment for the quality of learning
- What are the conditions of equity of evaluation, measurement, and assessment tools in the diversity of learning environments?

The research methodology included: the analysis of global trends in the management of digital assessment theory and technology, the development of the questionnaire "Social perception of teaching staff in the post-COVID-19 period", and the dissemination, collection, and analysis of respondents' answers obtained with Google Form.

The questionnaire includes 5 areas reflected in 13 items. The questionnaire was completed by 228 respondents - teaching staff participating in continuous training courses.

The results obtained:

1. Teachers know and apply a variety of tools for creating digital tests (Fig. 5.28)

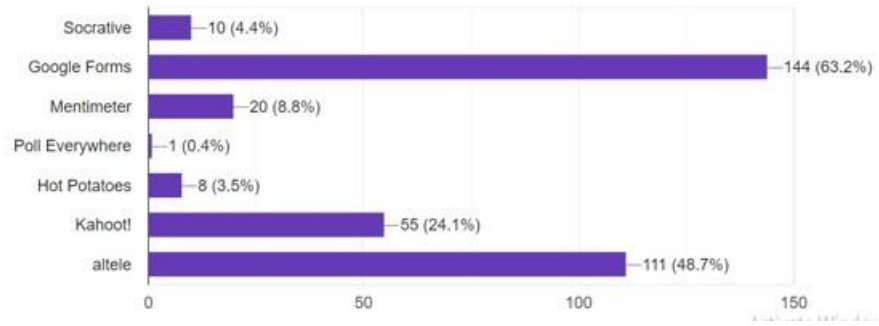


Figure 5.28. Google Forms as the most popular tool for creating computerized tests

In our opinion, this result is because the Google Form tool can be easily set up for the construction of computerized tests and, respectively, for their integration into the student's portfolio.

However, an open problem is the construction of item fragments and the intelligent analysis of verbal and graphic responses developed individually and/or in groups.

2. Teachers prefer strategies for evaluating learning outcomes, to obtain data about the knowledge accumulated by students (Fig.5.29).

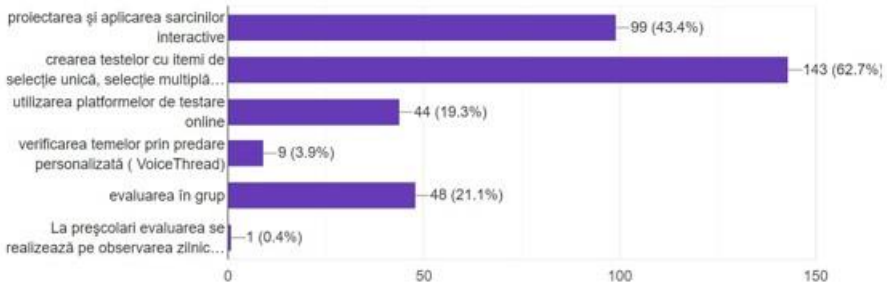


Figure 5.29. Highlighting knowledge assessment strategies at a taxonomic level

According to the majority of respondents, assessment is a measure of learning outcomes, and, respectively, they prefer item-creation strategies that correspond to the taxonomic level of knowledge (according to Bloom). This result can be considered a result of classical pedagogy in which the importance of teaching and evaluating the taught didactic material is highlighted. At the same time, teachers' interest in assessment management is attested. This argument is based on the response of the respondents who prefer to design piloted interactive tasks through the learning environment created by digital technologies.

3. The most important differences between computerized and traditional assessment are: computerized assessment is interesting, motivating, and objective (Fig.5.30).

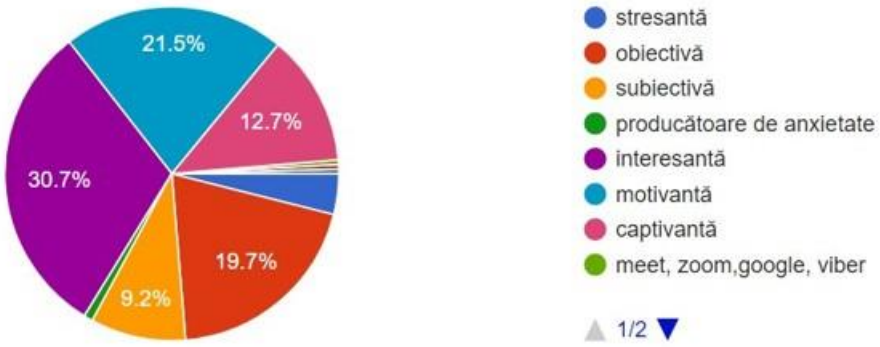


Figure 5.30. The teachers say that the computerized assessment method is more interesting

This result is in strict accordance with the idea that assessment measures the quality of the teaching process. At the same time, the computerized assessment, designed following the rigors of classic instructional models, is not sensitive to societal challenges, the score is highlighted in 13.6% of the total number of responses. Respondents know that this form of assessment is contextually determined (47.4%), so items and/or computerized tests can be scheduled for a strict date and/or time,

and under certain conditions the delayed assessment model is applicable. However, to achieve this goal, it is important to strengthen the ability to analyze answers.

4. The didactic design of computerized assessment is important for the quality of learning. However, the main role in didactic design belongs to the teacher (Fig. 5.31).

Figure 5.31. Responsibility for didactic design rests with the teacher

A special role in the management of computerized evaluation belongs to the design model of computerized items and/or tests. Teachers who apply classical design models state that computerized assessment is an opportunity to learn what will be assessed. With this statement, we sensitize public opinion regarding the issue of evaluation in the diversity of learning environments, which must and can be conceptualized from the perspective of intelligent analysis of the quality of item responses.

5. However, most of the time, the teacher's role as an instructional designer is limited to diversifying the ways of transmitting didactic material (Fig. 5.32)

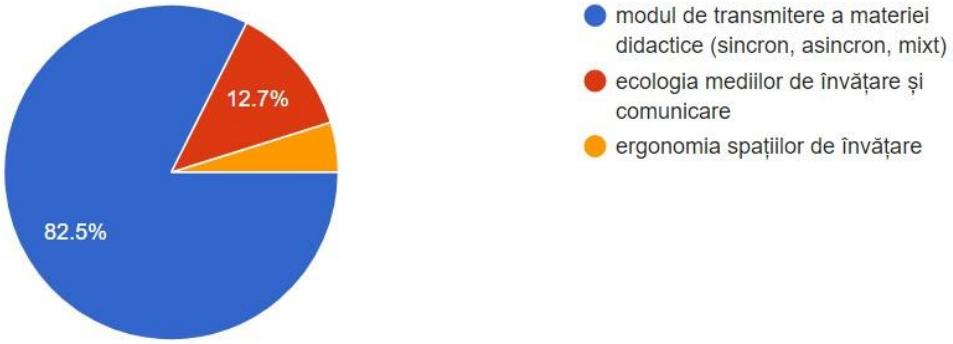


Figure 5.32. Prioritization of teaching methods

This answer derives from the result obtained in the previous question. The majority of respondents' responses (83.3%) reveal the opportunity to learn as determined by school resources, time for instruction, quality of instruction, inclusive practice, and the time needed for learning.

6. The conditions of fairness of assessment tools are: diagnostic activities, formative and summative assessment (Fig. 5.33)

Figure 5.33. Evaluation as a diagnostic, formative, and summative method

The analysis of the results allows us to state that teachers know and apply a variety of tools for creating digital tests, including Google Forms, Kahoot, and others. In our opinion, the design and elaboration of items and potential answers should be adjusted to the expected performance of the learner (corresponding to the Bloom-Anderson taxonomic levels that also includes metacognitive tasks). Thus, as an example, items with answers of the type "check boxes" and "short answer" are recommended for memorization; the items "linear scale", and "grid with several options" - for the levels "from comprehension to application", and the answers of the "paragraph" type - for analysis, evaluation and creation.

The most well-known evaluation strategies are focused on learning goals and allow to obtain data about the competences of learners, provide feedback, and/or monitor academic progress. This result is validated by the response to the item, according to which most teachers perceive assessment as a method of measuring learning outcomes, but are aware that assessment measures the quality of the teaching process, being a unique method to build learning based on the opportunities of the learning environment. The analysis of the ratio between the type of computerized items and the estimated educational purposes highlights that the tests with single selection and/or multiple selection items are the most requested. Such items are designed at the level of knowledge (according to Bloom-Anderson's taxonomy), but not for metacognitive knowledge and/or experiences. This issue requires careful study.

Practitioners' understanding of the difference between computerized assessment and traditional assessment is evidenced by respondents' answers that a) computerized assessment is a more interesting, motivating, and objective method. At the same time, the assessment is contextually determined, but not sensitive to societal challenges. Therefore, teachers are aware that computerized assessment can be a learning strategy that can and should be studied.

In the opinion of the majority of surveyed respondents, the basic role in ensuring the quality of learning rests with the teacher. But when we say that students are responsible for the quality of learning, it is important to assess the ability to learn successfully throughout life and, respectively, to promote such strategies, including through the learning environment constituted by digital

technologies. The promotion of scholasticism is proven by the statement: the most important for evaluation is the diversification of the method of teaching didactic material.

In conclusion, the management of assessment strategies derives from the quality management of assessment strategies, measurement, and digital testing, which represents the continuous process of designing, developing, implementing, and evaluating (meta)cognitive, affective, and psychomotor tasks carried out by the teacher in/for the diversity of real-virtual learning environments. From a metasystem perspective, the form of computerized assessment must be rethought to become motivating and allow self-regulation of learning by establishing the synergistic effect at the individual and social group level, and assessment management - a function of the learner. At the same time, assessment is a characteristic of appreciative intelligence and, accordingly, must be designed and carried out as a form of learning.

2.5.4. The ecosystem model of formative and summative assessment with practical applications

The necessary and sufficient condition of the feasibility of an ecosystem of learning and communication are the psycho-pedagogical norms for designing the learning environment with an emphasis on formative assessment.

In the article [92] the ecosystem model of the assessment is described. The specificity of this model consists in prioritizing the importance of a) (meta)cognitive tasks in formative assessment, b) learning analytics, and c) collaborative activities/methods for achieving a common goal. The limits of applying the ecosystem model of assessment in university course design are reduced to the permissiveness of digital technologies to design, analyze and monitor the quality of learners' responses. The conceptual model is represented in Figure 5.34.

Figure 5.34. The pedagogical design of digital assessment

The paper infers that assessment faces a series of global challenges caused by the dynamic change of the educational paradigm and the diversification of learning environments. One of the recent challenges is the prioritization of formative assessment in the context of the rapid transition to distance teaching through digital technologies. From this perspective, computerized assessment can be classified as an innovative form of learning, which leads to collaborative educational activities.

The permissiveness of collaborative activities in the real-digital environment is determined by the lack of time constraints; the multitude of learning spaces and their location; the possibility for the teacher to provide continuous feedback through digital technologies and the opportunities offered by the digital environment for the development and dissemination of own learning resources. For an adequate performance of these activities, the ability to self-regulate learning, the involvement of everyone in solving all tasks, the monitoring of answers (the formative evaluation stage), as well as the generalization of what has been learned through written communication (the summative evaluation stage) is important.

The course is divided into learning units. The didactic project capitalizes on cognitive and metacognitive strategies. Each learning unit is completed with tests, questions, or formative assessment exercises. Tasks are designed to actively 'engage' students in a reflective but productive self-discourse from which data will be obtained. Formative assessment, administered during course delivery, aims to develop critical thinking through problem-solving in a collaborative learning environment. The condition is the responsibility and autonomy of the learner. The basic idea lies in the mechanism of continuous feedback and delayed feedback. This mechanism consists of the meticulous analysis of student's performance of tasks with/through digital technologies.

The basis of the creation of the ecosystem model is the curriculum of the "Psychology of evaluation" course, and the pedagogical experiment was designed based on the objective of determining the specificity of formative evaluation for the formation of critical thinking skills. The methodological objective is to move to a model that would ensure the management of the metacognitive strategy in a predominantly digital learning environment. As a result, the students developed, in a collaborative digital environment, the digital content of the course manual, the formative assessment being part of the teaching-learning process.

The collaborative digital manual, monographic type, represents a set of hypertextual documents, structured in the following components (a) theoretical-cognitive (encyclopedic information, diagrams, multimedia sequences, animation, etc.) and (b) instrumental-practical (generalizations, conclusions, schemes mnemonics/conceptual schemes, etc.). Therefore, the digital textbook can be considered a collectively produced educational product. The originality of the educational technology consists of a) designing and developing the pedagogical model based on the dynamic and flexible strategy; b) maintenance of the project by measuring academic progress during learning and c) development of the manual (as validation of the achieved performance). Taking into account the fact that the pedagogical experiment was carried out in the exceptional situation caused by the COVID-19 pandemic, as well as UNESCO's recommendations to reduce any form of stress in the learning process, it was decided not to penalize the student who submitted the formative evaluation paper with delay. The basic criterion is the quality of the answers to the tasks and not the time of submission of the formative assessment paper.

3.0. GENERAL CONCLUSIONS AND RECOMMENDATIONS

The synthesis paper "Managing Global Education Theory and Technology in a Diversity of Learning Environments", carried out in the GAE paradigm (where G-globalization, A-anthropocentrism, E-existentialism), is current and important. The general hypothesis, tested in the studies carried out after the defense of the doctoral thesis, is: Global education is carried out on a scale of 1.0-3.0, with a tendency to escalate 1.0-7.0. The hypothesis investigated in this synthesis paper is:

If we analyze the phenomenon of global education from the perspective of the theory of metasystem design of learning, then we find that educational management is carried out in a diversity of real-virtual learning environments, which represent a global ecosystem of learning and communication, in which metacognition and successful learning strategies are prioritized, including assessment, measurement and testing strategies.

The purpose of the synthesis work, conceptualizing and substantiating the theory and technology management of global education in a diversity of learning environments, was achieved based on the following objectives:

O1: the study of the epistemological, epistemological, and ontological landmarks of the theory and technology management of global education and the argumentation of the problem, the purpose, and the objectives of the research;

O2: identify and describe the research paradigm and research methodology of global education theory and technology management in a diversity of learning environments;

O3: description of the management of metacognitive strategies from the perspective of the specifics of metacognition and successful learning strategies in pre-university and university education;

O4: identifying the role of ecosystem models in educational management;

O5: analysis of the specifics of management of evaluation strategies in the diversity of learning environments.

Global education is not simply a result of globalization. Initially, this statement is argued from a philosophical, sociological, and pedagogical perspective. The philosophy of global education is concerned with the question: What does knowledge represent for society and humanity? What skills need to be developed for the sustainable development of human society? What is the viable model of personality that must be promoted to properly educate the younger generation? From the perspective of pedagogy,

learning is carried out according to universal and global laws. Global education is a social phenomenon that highlights the responsibility of the learner to learn throughout life through training and self-training.

Theorists state that global education is a result of globalization. But globalization, as a process of uniting the world into a single system with global properties, can be described simplistically or extensively. Adherents of the first current describe the economic, educational, social, technological, demographic, political, and informational dimensions of globalization by the terms: "economic globalization", "educational globalization", "political globalization", etc. Adherents of the extended version argue that globalization is a dynamic phenomenon that has several phases of development.

The current phase, called informational globalization, is characterized by the "cognitization" of individual and social perception (as a result of the diversification of data, technologies, and environments, including opportunities to design, develop and control learning environments). In this situation, education is carried out within the limits: education 1.0 (expert teacher, passive student/student, digital version of the subject) and education 3.0 (learning designer teacher, active students/students, cloud solutions), but trends towards expanding the limits are observed education from education 4.0 (transformative education) to education 7.0 (education for spiritual intelligence).

The accelerated transition from education 1.0 to education 7.0 occurs against the background of anthropocentric transformations and deep societal changes, but also in the patterns of thinking. This situation can be described as follows: from linear thinking to metasystem thinking. Linear thinking generates static educational models, systemic thinking - interactive models, and metasystem thinking - generative and transformative models. But the emergence of metasystem thinking for the design and development of intelligent information systems occurs under the conditions of increasing uncertainty of the real environment, unprecedented societal challenges, as well as the fusion of physical, digital, and biological technologies. All this contributes to the rapid diversification of learning environments, a fact that can and should be taken into account for the design and development of user interfaces.

Pedagogy, as a science of global education, is faced with the dilemma: technologization or humanization. The methodological landmarks of the study of the management of the theory and technology of global education are determined by the principles of the Theory of Metasystem Design of Learning. This theory values learning and communication at the level of perceptual interaction with the object of learning, but also with the norms of existence in the global society. The theory highlights the link between (meta)cognition, ecosystem models of learning, and communication and assessment strategies, specific to the diversity of learning environments.

The Metasystem Design of Learning theory was validated by the metadata tabulation method. This method consists in analyzing the dynamics of the metadata, identifying the periods of the most significant events, delimiting the periods, and describing the results. Combining this method with the

scientific management of edited volumes makes it possible to establish the reference framework in a research field. The results are described in: "Handbook of research on Applied learning theory and design in modern education", "*Metacognition and successful learning strategies in higher education*", "*Ecosystem-based theoretical models of learning and communication*" and "*Assessment, Testing, and Measurement Strategies in Global Higher Education*".

The method of metadata tabulation, complemented with the techniques of stratification, clustering, analysis, and comprehensive description of metadata dynamics is a way that allows the description of global trends in the management of global education theory and technology. The results were disseminated at the EAPRIL2013 Conference and in the monograph "Metasystems Learning Design of Open Textbooks: Emerging Research and Opportunities". The same method, complimented with the possibilities of the "Google Books Ngram Viewer", allows the graphical representation of metadata and, respectively, observing and describing global trends in image form. The method was applied to represent the dynamics of open educational resources (open science, pre-print, ways of accessing scientific publications in the digital environment).

The metasystem transition effect was described by Turchin (1970). The layering of the graphic representation, obtained with the Google Books Ngram Viewer, allows for identifying metasystem boundaries in educational management. The method consists in graphically exemplifying the transition of the metasystem. The personal contribution consists in explaining the importance of the interdependencies between the metasystem elements, a fact that made it possible to elucidate the complex structure and the interdependence of key competencies as a model of the transition of metasystems at the level of 2018 (monograph: "Management of metacognitive strategies", p. 44). As a result, key competence is described as a holistic unity of knowledge, skills, and attitudes. The metasystem design theory of metasystem learning includes qualitative-quantitative methods that allow identifying the state of affairs in the researched subject according to the Hegelian idea.

The management of metacognition and successful learning strategies is an active research topic. Although the definition of metacognition was formulated in the seventies of the last century for pre-university education, the interest in the strategic component of metacognition is primarily due to current research in university education. Metacognitive strategies, consisting of planning, monitoring, and control strategies, cannot be separated from personal effort management and time management strategies. Research has shown that the management of metacognitive strategies becomes the condition for successful learning throughout life.

To ensure lasting effects, the teacher's strategy and the learner's tactics must form a tandem generating intrinsic motivation. The management of metacognitive strategies depends on the specifics of the learning environment; the "intelligence" of artificial technologies; the accents of the didactic project (cognition or/and metacognition, metamemory, comprehension, etc.). Because metacognitive strategies are

interdependent with the tactics and/or stratagems of the learner, the active involvement of all students in the teaching-learning process is important. There are differences between the management of metacognitive strategies. Thus, at the university stage it is important to take into account professional skills and learning needs; and at the pre-university stage - by the fact that motivation is determined by the reason/interest/curiosity to explore the new in the multiple forms of the learning object.

A special role belongs to ecosystem models of learning and communication. However, ecosystems are complementary and interdependent at the same time, so each ecosystem element has a strictly determined place and role. Ecosystem sustainability is ensured by energy and data/information flow. Therefore, the learning and communication ecosystem represents a structural unit of global education with functions determined by the opportunities of the global educational environment. The necessary and sufficient condition is the permissiveness of digital technologies. Such models can be classified into theoretical ecosystem models; ecosystem models for e-learning; ecosystem models of social partnership and ecosystem models of signs, language, and intercultural communication. In each of these models, the most important role belongs to the learner's performance and its maintenance throughout life.

The functionality of the learning and communication ecosystem is ensured by the environmental resources (energy, light, temperature, water quality, oxygen quantity, etc.), digital tools, and the energy needed to carry out (meta)cognitive activities/actions. Therefore, in the feasible design of a learning and communication ecosystem, the following are important: cognitive ergonomics, the effort required to carry out (meta)cognitive activities in a diversity of learning environments, the ability to learn throughout life, but also effort management, time, risks, opportunities, etc. Another global problem that requires urgent solutions is the impact of soft power on the action and decision-making capacity. This issue in the field of educational philosophy, pedagogy, management, and leadership explores the emergence of a new culture of teaching, learning, and assessment, called "a new normal", specific to the post-digital era. This new culture of learning specific to the diversity of global learning environments needs to be studied in detail.

Computerized assessment and external control is a specific problems in the management of global education theory and technology. On the one hand, this problem is caused by the permissiveness of the digital environment and, on the other hand, by the diversification of the assessment method into assessment strategies with an emphasis on three global trends, called assessment of learning, assessment for learning, and assessment as learning.

However, the global trend "toward a new normal" cannot be achieved without quality management of evaluation strategies. The study of this issue allows us to state that teachers know and apply a variety of computerized test-making tools, but prefer classic assessment strategies to obtain data on the knowledge of learners accumulated in a predetermined period. At the same time, they

note that computerized assessment is interesting, and the teacher is responsible for the quality of the assessment. This belief allows us to conclude that the management of assessment strategies is a derivative of quality management and reflects a continuous process of designing, developing, and evaluating tasks in/for the diversity of real-virtual learning environments.

Based on the obtained results, a research direction area was highlighted, called educational metasystemology - frontier science of pedagogy and educational management. This science constitutes the first derivative of the study of the epistemological foundations of the theory and technology management of global education; being argued by the principles of the metasystem design theory of learning realized in the global ecosystem of learning and communication and tested by assessment strategies in the diversity of learning environments. The object of study of educational metasystemology is the activity of planning, monitoring, and evaluating successful learning strategies throughout life to ensure the synergistic effect of learning. The complexity and dynamics of metacognitive variables (consisting of a) knowledge about person factors/variables, b) knowledge about task factors/variables and c) knowledge about strategy factors/variables) need to be studied from the perspective of global trends in the study of philosophy, pedagogy, psychology, sociology, management science, etc. The synthesis work is innovative and original, being grounded epistemically and methodologically by:

• *new concepts and ideas* (educational metasystemology, metasystem learning design theory, management of metacognitive strategies, management of evaluation strategies, etc.), which derive from the rationalization of the metasystem approach and, respectively, the methodology of course planning, monitoring, and evaluation / of the university course manual;

• *the theory of the metasystems learning design and methodological applications* (metasystem, metasystem transition in the study of key competencies, metasystem approach, metasystem methodology for investigating global trends and problems, qualitative-quantitative methods of identification and immediate analysis of respondents' opinion, etc.);

• *the interdependence between metacognition and successful learning strategies* in higher education (the tandem of learning strategy-tactics, the role, and place of strategies, the importance of metacognitive knowledge and experiences, management of metacognitive strategies);

• *metasystemology of ecosystem models of learning and communication* and practical applicability in educational management and data-based leadership (the ecosystem of collaborative learning, ecosystem model of formative and summative assessment, etc.);

• *the specifics of the management of assessment strategie*s in a diversity of learning environments (assessment as learning, assessment as measurement, meta-assessment, interdependence between formative assessment and summative assessment results, collaborative digital manual, etc.).

Limits of research and potential research directions related to the topic addressed

This research has some limitations, but each limitation provides a solid and meaningful foundation for future studies into the problem addressed. First of all, although the ideas of the scientific works published at IGI Global were joined by scientists from the Republic of Moldova in comparison with researchers from the USA, Romania, Canada, Malaysia, Portugal, the Russian Federation, China, Turkey, Slovakia, India, Thailand, Sweden, Switzerland, Greece, Hong Kong, and Australia; the number can be expanded in future book projects to the topic addressed, thus substantiating the research area of educational metasystemology. This new direction of research focused on the analysis and synthesis of scientific results obtained in various learning environments and disseminated in the global educational environment, brings added value to open science considering that it allows updating the database in the topic addressed, including, for researchers from the Republic of Moldova.

Second, although the sample of scientific research is appropriate to examine the concepts: of "metacognitive strategies", "ecology of knowledge", "ecosystem of learning and communication", and "management of assessment strategies", a possible research direction is to investigate emergent concepts in the research area of educational metasystemology (e.g. global crisis of learning motivation and its management; learning risks and risk management), possibly by diversifying metadata, number of respondents and other constants and variables.

Third, the present study is cross-sectional, which indicates that the current results have painted an overall picture of how global trends and/or respondents' views are evident at a given point in time. The initiation of longitudinal studies in educational metasystemology would allow the understanding of how paradigms, theories, and models of learning regarding the concepts of knowledge, skills, planning strategies, monitoring, evaluation, successful learning strategies, and external control strategies, change over time. , as well as to examine how these metaphors relate to each other during teacher professionalization. Finally, the categories present in this paper were obtained based on qualitative analyses. The validity and reliability of these categories should be investigated in future studies and quantitatively.

Proposals for the use of the results obtained in the socio-cultural and economic fields

New research directions were initiated through theses presented at scientific forums, such as:

• the study of global education as the integrity of pedagogy, psychology, and sociology [93];

• the ecosystem investigation of specific open education pedagogies [94];

• identification of pedagogical design norms applicable in nano learning [95].

The obtained results are applicable for new scientific research, as well as for the planning, monitoring, and evaluation of the quality of continuous training courses for teaching staff.

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