



LIFE EXPERIENCE
knowledge,
attitudes (values),
skills -

FOR LIFE
cognition,
consideration,
behavior !

University of Latvia

SYSTEMOLOGY of EDUCATION

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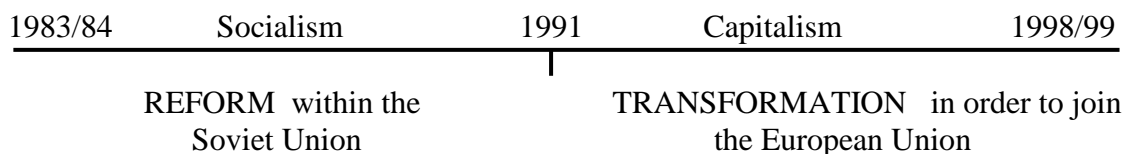
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PART 3. SYSTEMIC RESEARCH AND DEVELOPMENT OF EDUCATION

CHANGES (REFORMS AND TRANSFORMATIONS) IN OUR LIFE AND EDUCATION : LATVIA 1993 – 2000

1. INTRODUCTION

The 20th century – one of the most complicated centuries in the history of the world, as well as in the history of Europe and Latvia – is finished. This has been an era of very remarkable scientific and technical progress, a time for intensive globalization of political, economic and social processes. It's been a century during which Latvia has three times experienced changes in the lifestyle orientations of the East and the West. As the varieties and pace of life have increased radically, *Latvia has, over the last 15 years, implemented very serious changes in the lives that we live.*



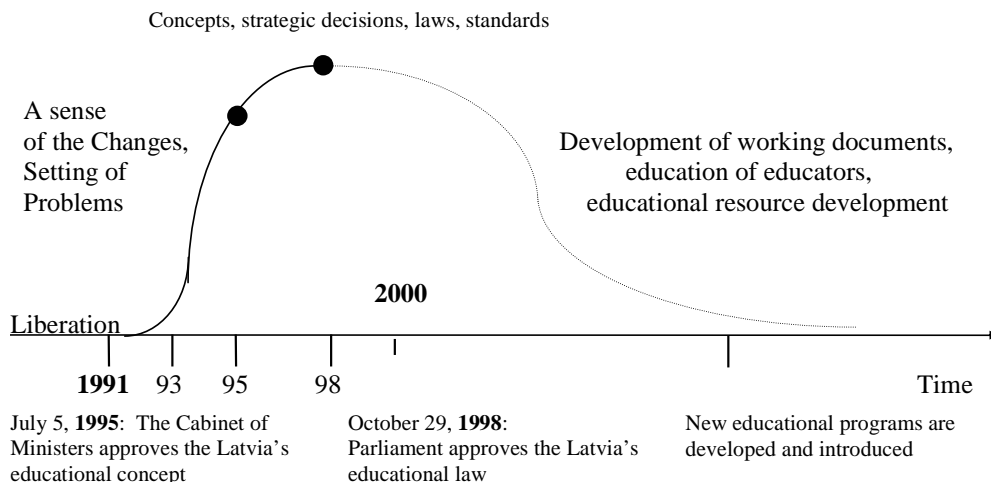
Educational activities or *education* is a specially organized process and result aimed at gaining life experience for life. Changes in life mean changes in education, too. However, as is always the case during important changes in the life of society, the main phenomena that are considered initially are political and economic problems. Other social problems move into second or even third place for a while, and the corresponding sectors, including education, survive the respective period of time very humbly, even in poverty. The situation in education is made all the more difficult by the fact that this sector has traditionally been – and continues to be – in the hands of the state, and as the result of fairly spontaneous processes of denationalization and decentralization, the state has become notably weak. Along with the aforementioned problems, careful evaluation and successive action is also required by the need to establish a quality of education (in terms of content and levels) that corresponds to the new needs of society. Finally – and this is particularly important in this time of change – Latvia needs an effective management process in its national educational system (educational policies, the economic and direct management aspects of education, quality measurements), its reestablishment and its ongoing development. Generally speaking we can say that a new system of education is being established in Latvia.

We are in a period of transition from socialism to capitalism. What does this move mean in terms of **changes as reforms and transformations** in education? The first thing that we need to do is to understand and comprehend very clearly that **the development of Latvia's educational system is happening in very tight correlation with changes in all other aspects of human activity.** The main transformation in Latvia can, generally speaking, be described as rapid liberalization of life. In this reorientation toward the living standards of the Western community (Western Europe and the United States), it is for the time being necessary to understand as clearly as possible the lifestyles of the contemporary West – its riches and its tragedies, the losses and gains that we can expect, as well as the modern problems of the West. All of this must be taken into consideration immediately in developing the Latvia's educational system, in setting up proper educational content and levels, and in organizing and implementing educational activities.

Since the restoration of Latvia's independence in 1991, a very important area of education-related activity has been the development of the **educational sciences** in the country. That is because an acute need has arisen **to resolve all of the education-related problems in the country ourselves.** This means that there is a need for a much broader, deeper and more highly correlated view of education than was the case in the Latvian SSR, when the basic solutions of educational problems were dictated to us. This was a sleepy period of carelessness, and after the Latvian national Awakening, we found that we were unable to resolve such fundamental non-pedagogical educational issues as educational policy, the economics of education, the quality control of education, etc., in a sufficiently effective and purposeful way.

The last years (1991-1999) were a period when Latvia underwent new development and improvement of its educational system. There were serious changes, and self-development was initiated, a process during which we have found both inertia and chaos, as well as the initial beginnings of a new order. Evaluating eternal truths, changing their contemporary aspects, and moving along with changes in life, with their own challenges, and with their own common sense, **trustworthy performers of educational work in schools, local governments, universities and educational management institutions have laid the foundations for the development of a new Latvia's educational system.** That is where we see the genesis of the development of our own educational sciences, the justification for this process. Intensively studying foreign experience and taking into account the specifics of our local life, we have reached a level of conceptual solutions to our problems which must as soon as possible be implemented into concrete practice.

CHANGES (REFORMS AND TRANSFORMATIONS) IN LATVIA'S EDUCATION



A properly ordered life is linked to an orderly life experience – education, spiritually and physically healthy people. Under conditions of rapid changes in life, it is logical that there is a lack of correspondence between previous life experiences (education) and the new needs that emerge in real life. Averting this lack of correspondence is a key reason why any country's educational system must be brought into better arrangement (as definite balance of order and disorder) through a creative evaluation of the contemporary content and forms of eternal values of life, maintaining or supplementing those basic values in concert with the times.

Disordered life, albeit with a certain inertia, eventually brings a corresponding disorder to the naturally conservative educational system. The extent to which an educational system is properly ordered under conditions of changes in life is dictated by the extent to which other areas of life in the country are in order. The kind of life that will exist in Latvia tomorrow and the role which Latvia will play in the processes of the world – that's the kind of life experience and education that will exist in Latvia, and that's the kind of educational system that the country will develop. In other words – life and education always are closely interrelated.

When it comes to the development of Latvia's educational system today, the main goal is to study the experience of educational activities in this country and in others, seeking to structure educational activities in as orderly a way as possible, even as the country accumulates its own experience in this area.

The development of Latvia's educational system today requires a broader and more open view of education that is linked as much as possible to our real life today and coming future. The intellect and morals of Latvia's specialists will be the key here, no matter how significant external influences may be in the life of a small country and nation.

If there is to be stability in life and sustainable development for society, its various groups, the state and non-governmental organizations, as well as individual residents of the country, Latvia now more than ever must ensure that its activities are not without accomplishments. We must devote all of our forces and energy to overcome the long-standing tendency to twiddle our thumbs as time goes by. Second, we must ensure that there are no backward steps – instances when work that has already been begun is, without any good reason, started anew, instead of developing and improving that which has already been achieved. And third (and most important), we must seek out, find and avert the causes of stagnation in these development processes – causes that are usually rooted in a general and concrete absence of purposefulness in the activities, as well as in insufficient abilities to analyze, plan and implement the necessary activities in pursuit of the specified goals. The insufficiency of ordered (systems) thinking and action, confusion in relation to shifts in value orientations, surprising moral inconsistencies – these are the main shortcomings that are revealed in modern-day changes in life and education in Latvia.

**UNDER CONDITIONS OF TRANSFORMATIONS IN OUR LIFE AND EDUCATION,
A NEW ARRANGEMENT EMERGES FROM TRANSITIONAL CHAOS.**

We have the chaos of transition, we will have new arrangement (order and disorder balance), and our life and our education will become more wealthier, as long as we want that to happen and take the necessary steps to ensure that it does happen.

Since the Latvian national awakening that concluded with the achievement of our state independence in 1991, our country has been born anew, and under completely new circumstances. New problems have emerged – new developments, relationships between the

old and the new. Changes all around us and within us – these are the laws of eternity itself. **The one who changes in accordance with the development of things and processes in the world will survive.**

Our lives are part of the processes of the world and all changes link each of us to our living environment. Bringing together the material and the spiritual, the life of any individual (person) is a process of change that has to do with the person's appearance, existence and then disappearance from the world. Human's life in the world represents the implementation of his life in connection with other people, the whole process taking place in the respective natural and technical environment.

Each person perceives and implements his life in the world in an ordered way. Order in any environment occurs alongside disorder and therefore the order-disorder balance is so fundamental characteristic of any situation. Anything that we know – both things and processes – has an internal and an external arrangement as definite balance of order-disorder. **A definite arrangement always is the foundation of the physical and psychic well-being of each of us, as well as of a healthy lifestyle.** A healthy person in a healthy environment – that means proper arrangement of the person's spirit, flesh and living environment. Order-disorder balance or arrangement is a concept that is used to describe the extent to which all of the environments that are of interest to a human being are arranged or in disarray. In specific conditions transitional processes start, and one order-disorder balance is replaced, via chaos, by another order-disorder balance (arrangement).

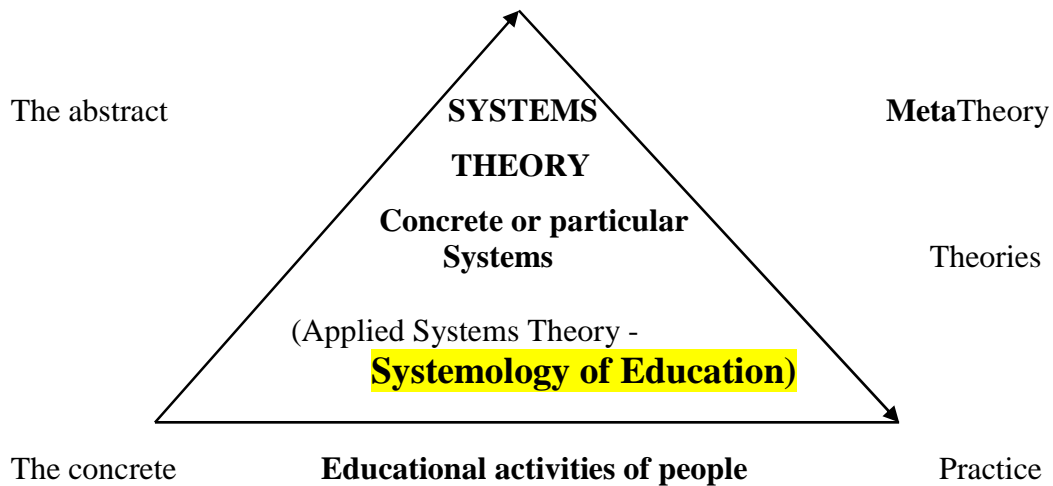
The way in which we understand and comprehend our lives and our world, as well as the way in which we act, are dictated by the procedure of our thinking. Basic knowledge about the typical arrangement of these processes of the psyche is traditionally offered by logic – the science that concerns thinking. Along with development of formal logic, mostly on the basis of modern natural sciences and technical methodologies, in the mid-20th century a very effective theory and practice concerning the operations of our minds appeared – “systems theory”, or what is known also as the theory and practice of “system approach” or “systemology”.

SYSTEMS THEORY means general theory about the arrangement of the world phenomena reflection within human's consciousness in terms of order – disorder balance, being an expression of interconnection of everything in the world.

Systems theory – it is fundamental result of the study of modern complex phenomena in the world, it is modern general theory of world's complex reflection within human's consciousness. The **basic principle of systems theory** is such as follows: **the origin or cause of everything is the interconnection among everything - any definite arrangement of everything is a result of corresponding interconnections or interactions of everything.**

Systems theory today is applied scientific philosophy and psychology, a universal theory of human's common sense. It is a methodology concerning a sensible person's (*homo sapiens*) world view. Every phenomenon of the real and imagined world (a thing and/or a process) is reflected as a system. That is why these days we are increasingly finding the terms “system”, “system structure and properties”, “system analysis and synthesis”, etc., and using them with a greater or lesser understanding.

**SYSTEMS THEORY WITHIN THE STRUCTURE
OF HUMAN'S UNDERSTANDING AND COMPREHENSION OF THE WORLD**



Today, when our lives involve global shifts as different changes as corresponding reforms and transformations, the conscious application of the ideas of systems theory in education becomes particularly important. The research and improvement of educational systems in accordance with the new conditions of life are expressed as a solution to the overall problems with bringing new arrangement to this area of human activity.

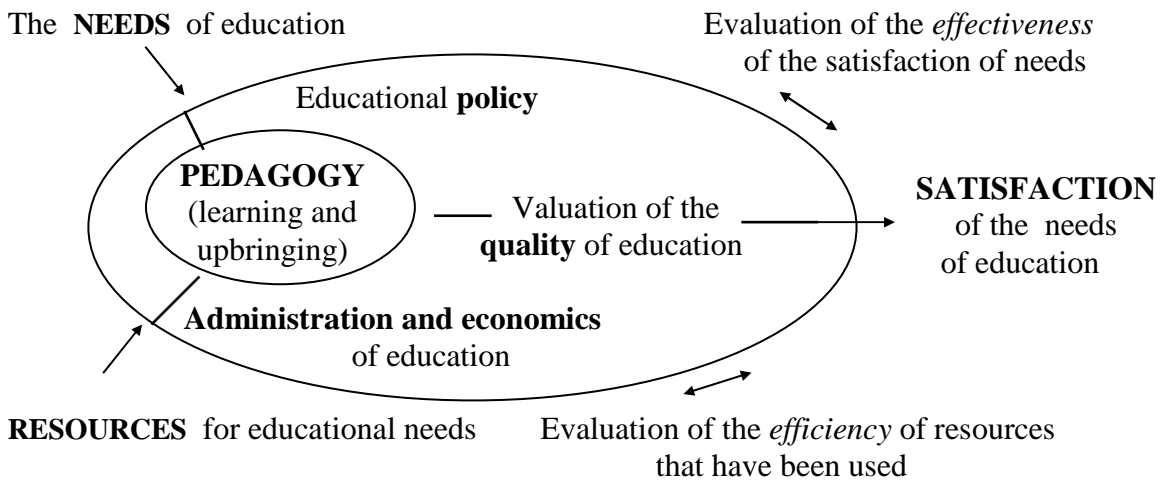
The term “educational system”, which is used so very frequently, is the best way to see the process of systemology in educational activities. Unfortunately, the frequency with which the word is used does not in and of itself affirm a sufficient understanding and comprehension as well as conscious use of the concept. Even though many educational leaders, as practitioners with good common sense, are in essence accidental system theorists, the fact is that theoretical enlightenment improves their work to a considerable degree. We must always understand that the sensible person is always interested by the *properties of systems* as a final result – their conscious use and transformation in concert with one’s interests. Systemology of Education, as a theory that is to be applied in practice, serves mostly as an affirmation of the sensible direction of one’s own thoughts, considerably stimulating the further optimization of one’s work in Education

1. UNIVERSAL FUNCTIONAL STRUCTURE OF EDUCATIONAL SYSTEMS.

If we look at our lives as the implementation of a specific order of things and processes, then the order that is set up characterizes the experience of human life, i.e. – education. If we abstract ourselves from the content of education and the concrete way in which that content is learned, we first of all reveal the systemic structure of **educational activities as purposeful activities**.

Any purposeful activity is a procedural system that, in a macro view, is a whole that exists in an environment of other activity, while in a micro view we gradually reveal the hierarchical structure of the activity as a linking of the various parts into the whole. Any purposeful activity, in a macro view, is related to the surrounding or external environment in three ways. The environment usually proposes the **NEEDS** which must be satisfied by the activity. In order to carry out the activities, the environment provides the necessary **RESOURCES** (in special cases taking advantage of the internal resources of the entity that is performing the activities). When the needs encounter the proper resources, the activities are performed, and the environment enjoys the **SATISFACTION OF ITS NEEDS** as the result of the activities that have been performed.

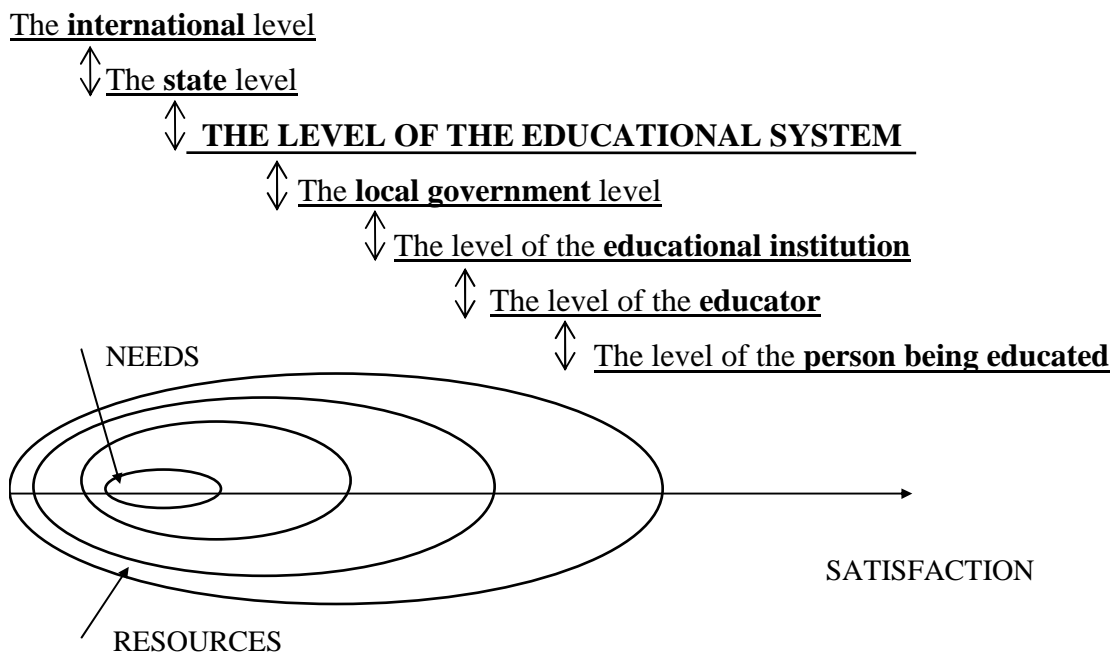
THE FUNCTIONAL STRUCTURE OF EDUCATIONAL SYSTEMS



All purposeful activities are first and foremost described by blocs of management and execution activities that are linked by a direct and a reciprocal relationship. The bloc of management activities, in turn, is shaped by the elaboration of system's operational goals, the detailed administration and resource supply for the activities as well as self-control over the activities (quality control). Bringing these general ideas closer to the terminology used to describe social systems, we find that the elaboration of operational goals represents the formation of operational policy, while the direct management of the implementation of the activities has to do with administration and economics; control means an evaluation of the purposefulness and quality of the activity.

Along with the internal control over educational activities, there are also external processes of evaluation, with society specifying the effectiveness of the way in which needs have been satisfied, as well as the usefulness of the resources that have been applied. As can be seen in the next figure, the functional structure of education that was described in the first figure conforms to the organization of educational activity at all of the levels of its implementation.

THE HIERARCHY OF THE FUNCTIONAL ORGANIZATION OF EDUCATION

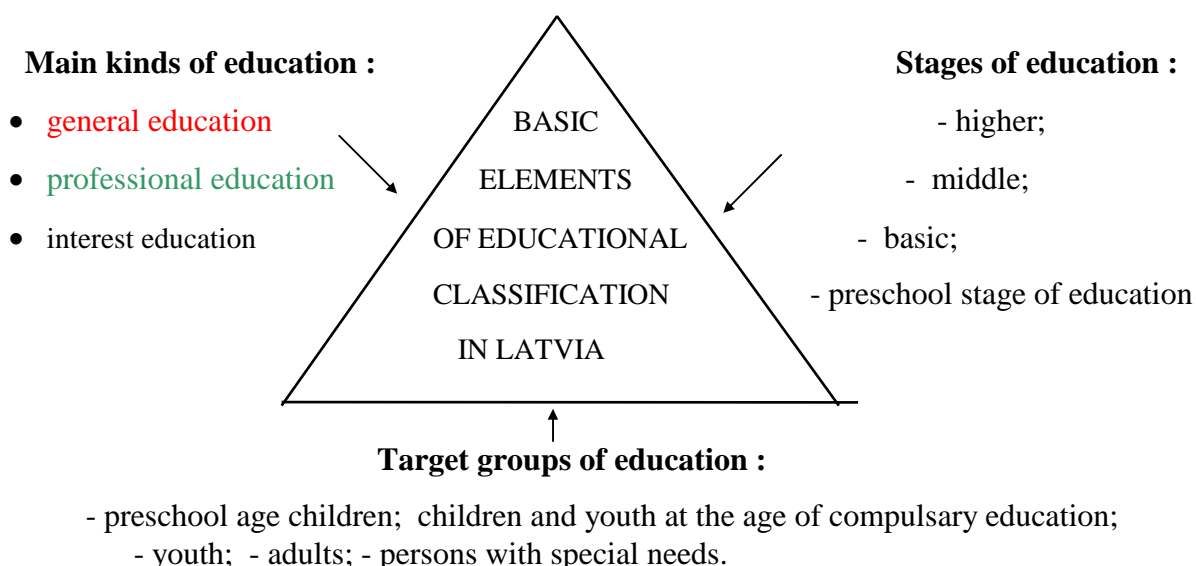


2. STAGES, KINDS AND TARGET GROUPS OF EDUCATION.

There are three main aspects of characterizing educational systems, when paying attention to the content and methods of educational activities. To separate those actions by means of its complexity the notion or concept **STAGE OF EDUCATION** is widely used. According to the possible use of obtained education the notion **KIND OF EDUCATION** has been introduced. Finally, if taking in account specified needs of different social groups of people, the notion **TARGET GROUP OF EDUCATION** becomes useful. Such principal classification of educational activities today is quite international with only some national features in different countries. Following schemes illustrate systemic view on this classification according to Latvia's system of education.

There are some other classifications also used in the framework of life long education : formal and informal education, initial and further education as well as very important kind of education - interest education

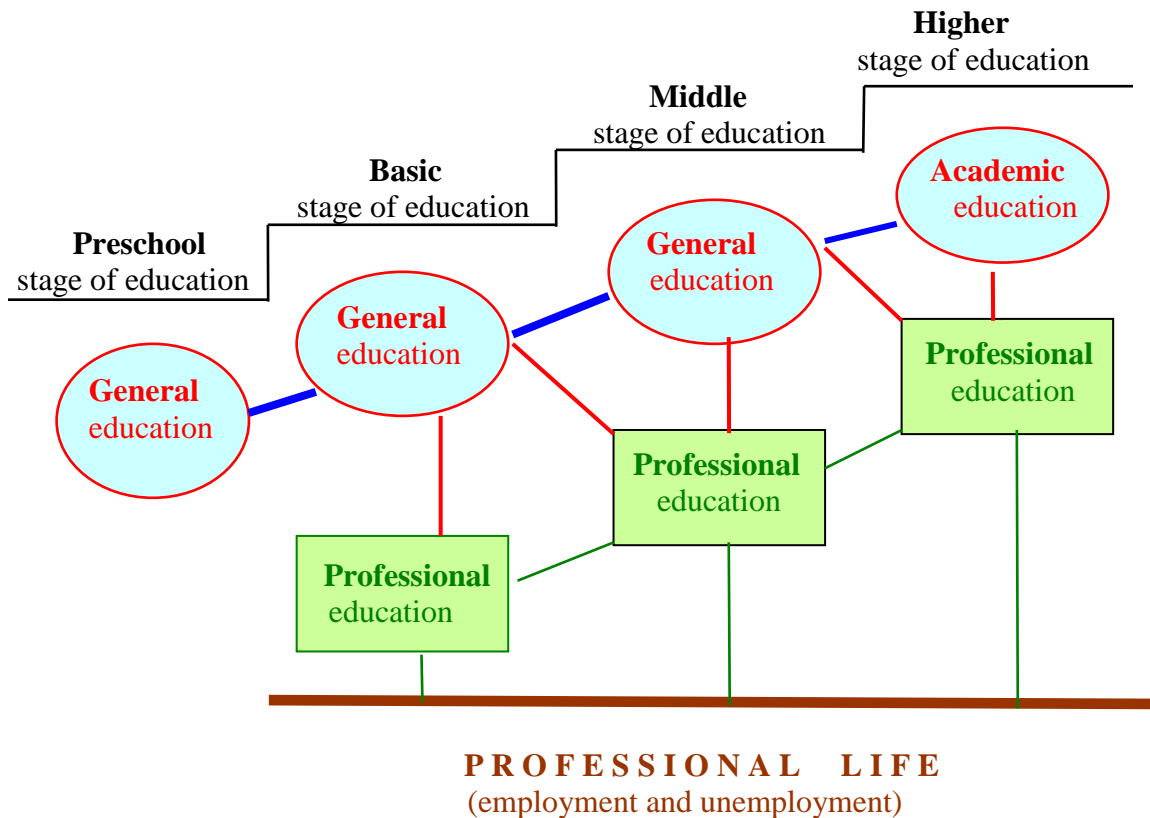
STAGES, KINDS AND TARGET GROUPS OF EDUCATION IN LATVIA



INTERCONNECTION OF STAGES AND KINDS OF EDUCATION

Kinds of Education Stages of education	GENERAL education	PROFESSIONAL education	Age
	HIGHER	Academic (bachelor, master studies)	Engineering, Medicine, Sports, Social work etc.
MIDDLE (grades 10 to 12)	*	*	16 to 19
BASIC (grades 1 – 9)	*	*	7 to 16
PRESCHOOL	*		From 2 to 7 years
Formal and informal education, initial and further education as well as INTEREST EDUCATION			

STAGES AND KINDS OF EDUCATION (formal education)



3. EDUCATEDNESS – SYSTEMIC CHARACTERISTIC OF THE EDUCATIONAL STATE OF THE PERSON

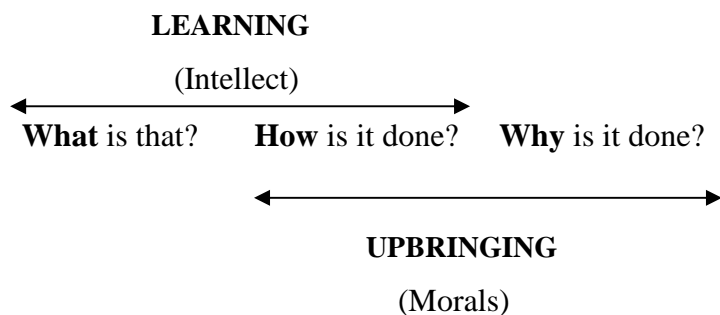
Under conditions of serious and rapid changes in our life, it is very important to conduct a systemic development of the education that persons or society at large have received, e.g. – **the quality of educatedness as the indicator of obtained education.** It is very much necessary to look at the changes that are occurring and to separate out that which is eternal or comparatively unchanging, preserving it and supplementing it with the content and level that are demanded by new needs in life.

If we consistently look at educatedness as life experience that people have obtained in a specific way, and if we separate out the **three basic elements of human life experience (knowledge, skills, attitudes)** in connection with the person himself, with the human environment and with the natural and technical environment, then we can shape a voluminous yet compact matrix-shaped review of the fundamental content of human educatedness.

The three aforementioned elements of educational content essentially dictate the basic structure of all of the educational programs that are elaborated ; initially they were set out in the Latvia's educational concept, and later they were also included in the country's new education law. At this time they are being described in greater detail in the country's educational standards.

THE GENERAL STRUCTURE OF THE CONTENT OF EDUCATEDNESS

THE HUMAN IN THE WORLD	KNOWLEDGE	ATTITUDES (VALUES)	SKILLS	← GENERAL PARTS OF LIFE EXPERIENCE
<i>The human among humans</i>	About society	Toward other persons	To live in society	Arts, Sciences, Technologies
<i>The human himself</i>	About himself	Toward himself	To deal with himself	Arts, Sciences, Technologies
<i>The human in the natural and technical environment</i>	About the living and non-living environment	Toward nature and technology	To live in a modern natural and technical environment	Arts, Sciences, Technologies
	COGNITION	CONSIDERATION	BEHAVIOUR	

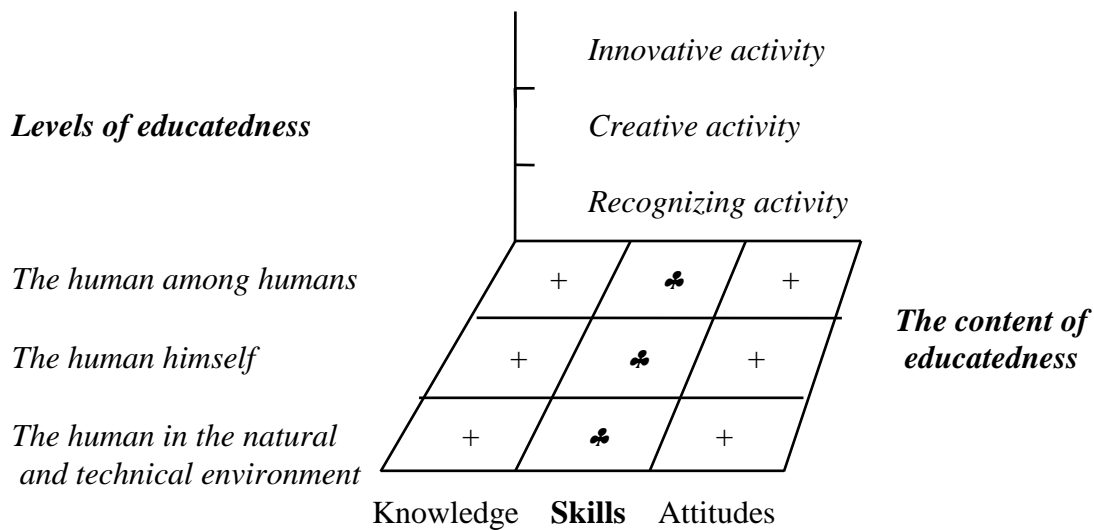


**Educational activity – it means learning and upbringing
 as organized gaining of life experience for life**

By viewing the elements of this matrix more concretely and by placing the necessary accents on the process, we find a highly varied description of the respective educational program, as well as the subjects or courses that are contained therein.

Educatedness affirms itself fully in person's life activities, and the content of education that has been obtained is revealed at the level of recognition, creativity and innovation. These three fundamental levels are the basis for any system to evaluate the education that has been obtained, irrespectively of the way in which the level of educatedness is evaluated (points, grades, etc.). A combination of the content and level of educatedness have been used since time immemorial to describe the quality of educatedness of an individual or his society. The educatedness of society is most often described with the help of corresponding statistical distributions, while the education that has been obtained by an individual is affirmed by documents that the respective person has received.

THE QUALITY OF EDUCATEDNESS (CONTENT AND LEVEL)



When it comes to the development of Latvia’s educational system, these universal schemes allow us to see several important issues with greater clarity.

First of all, the scientific and technological revolution that occurred in the Western community at the turn of the centuries has materialized in the form of highly effective, global transportation, energy and information networks, and it has devoted far too little attention to the nurturing of human values and orientations. The technocratization of human lifestyles, which is characterized by a distinct emphasis on the sciences and technologies under conditions of market economics and liberalism, has developed much more quickly than human attitudes have changed. Environmental protection problems are discussed often and are very important, but in fact we are talking about the attitude of humans toward other humans here.

A second factor is that as the variety of things and processes in the world expands with inordinate speed, as the number of human contacts rises, as lives speed up – accents are clearly being shifted these days from the need to learn a great deal of knowledge to the need to be able to work with that knowledge. Self-education is playing an increasingly important role here. At the same time, however, we must deal with the ancient problem of separating those things which must be learned with full understanding and comprehension from those which can simply be memorized. The modern illiterate not only fails to be able to read and write, he also cannot press the appropriate buttons. But are we, and will be it continue to be protected against senseless (insufficiently understood, ordered or responsible) pushing of buttons in this time of technological superiority?

Events are developing so quickly these days that many people throughout the world cannot follow along, they cannot adapt. Societies become polarized, stratified, and social tensions are on the rise. All of this allows us to conclude that there is a growing need to adjust accents in modern life and in education. Will we have the far-sightedness that is needed to accomplish this?

4. EDUCATIONAL PROGRAMMS AND STANDARDS.

A new order is also required today by the way in which educational processes are offered and implemented. Experience in educational activities in other countries of the world suggests that **educational programs** are the answer. Educational programs are the way in

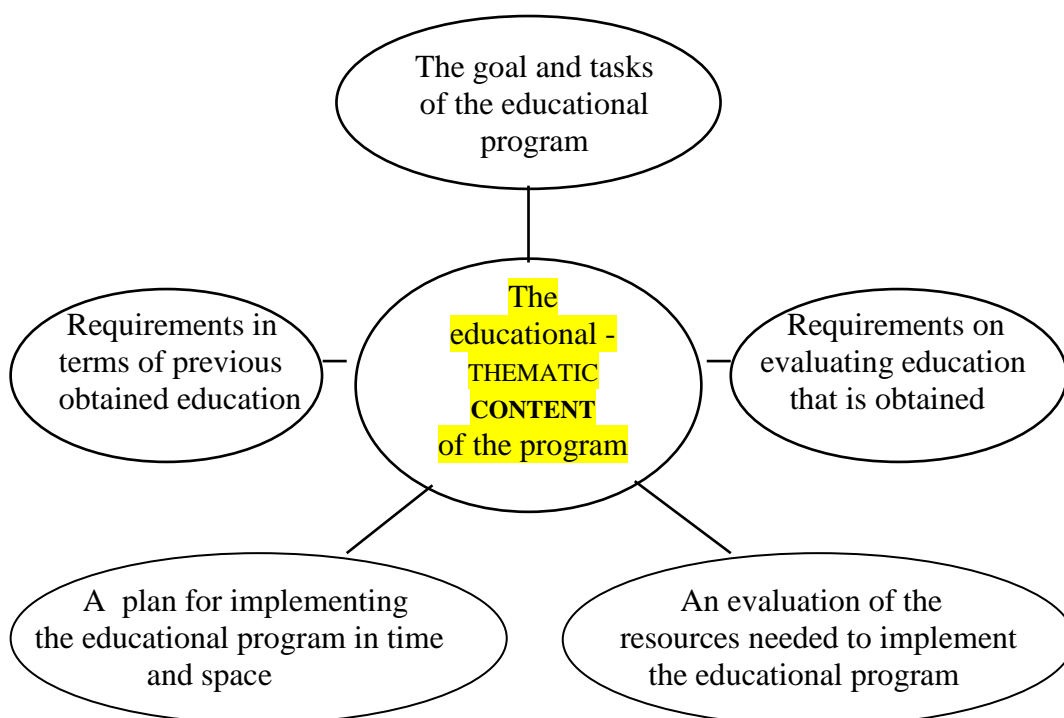
which educational offers are made to those who would receive the education. For those who provide educational processes, programs offer documented methods for implementing the necessary educational activities.

After a fairly long process of consideration and search for understanding and comprehension, the newly established structure of Latvia's educational programs is finally beginning to take root in Latvia. The main problems in introducing this necessary innovation have emerged from the fact that it has been difficult to look at educational activities from a broader and more correlated perspective. Latvia's educational programs are more than just a statement of educational content, more than just the curricula that have always been used. The educational programs are made up of six systemically linked elements that bring both spiritual and material aspects into the mix.

Educational programs in Latvia are elaborated by the institutions that are to implement them. The work is done in accordance with educational program standards and applied norms. The Ministry of Education and Science organizes the elaboration and approval of the most important educational program standards, and it also organizes the preparation of sample programs in the most common areas. As national educational program standards are set out, the state specifies generally recognized and unified basic requirements with respect to educational goals and tasks, the content of education, as well as the way in which learning is evaluated. As long with the mandatory requirements that are set out in these standards, the state also allows schools and teachers to demonstrate self-initiative in coming up with creative elements in this area.

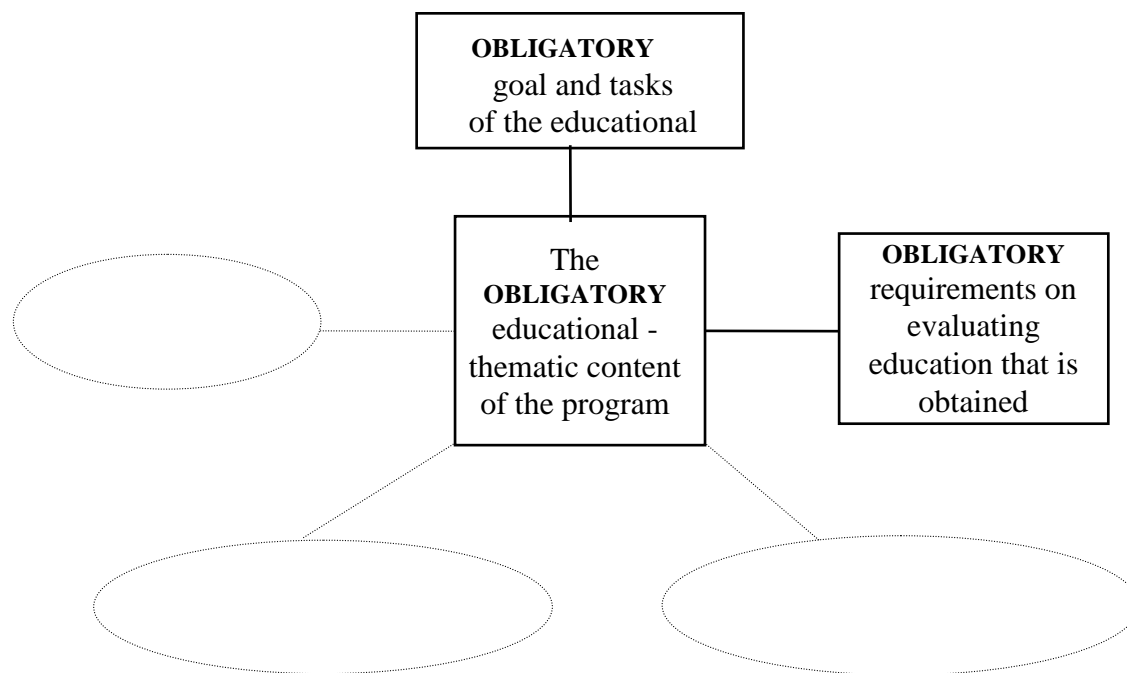
One thing that is very important is to protect those who are trying to get an education against low-quality educational offers. This is done in Latvia by **licensing** the implementation of concrete educational programs in the various educational institution (i.e., permits are received to begin the respective educational process), and by instituting a process of **accreditation** (i.e., the institution is authorized to issue a nationally recognized document attesting to the student's having obtained the respective education).

THE STRUCTURE OF EDUCATIONAL PROGRAMS IN LATVIA



Finally, of particular importance in bringing greater order to educational systems is the need to ensure links among the various educational programs when it comes to entrance and exit requirements in the programs. Throughout the world these days, educational programs are gradually being harmonized not only within individual countries, but also at the international level. The classification of educational programs is done in accordance with the stages, types and target audiences of education, while registration is done via various educational program registers. In Latvia the classification is based on the UNESCO-approved international educational classifier ISCED-97.

THE STRUCTURE OF LATVIA'S EDUCATIONAL STANDARDS



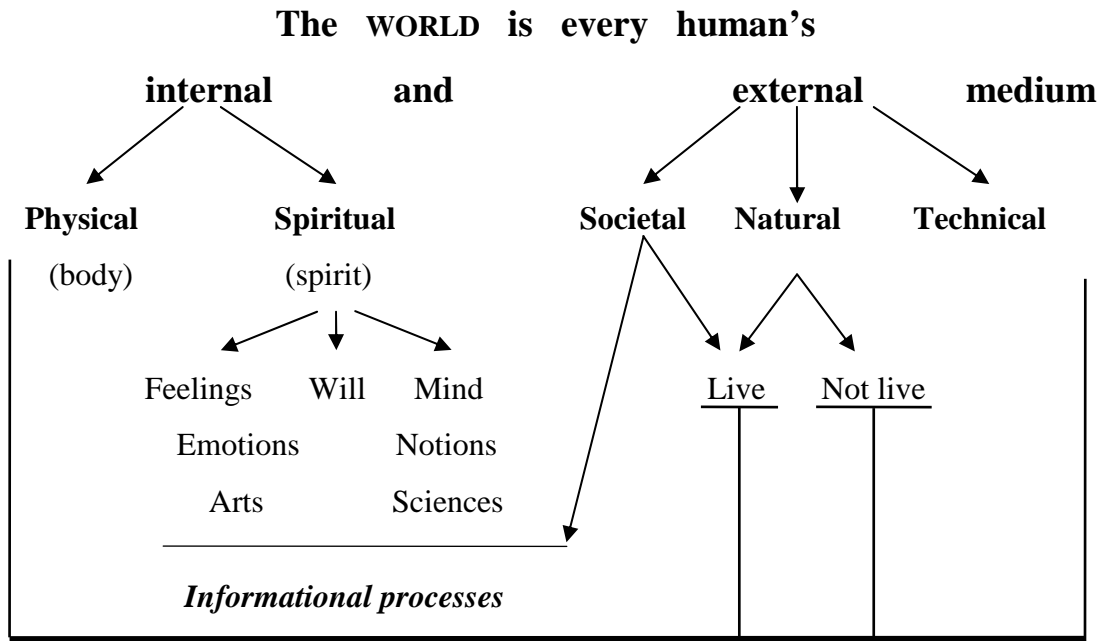
5. SYSTEMIC DEVELOPMENT OF EDUCATIONAL CONTENT AND METHODS

A systemic view of the world is of extreme importance in the educational activities of mankind – both in terms of educational management and in terms of pedagogy. Only an educational worker (educator) who is in full spiritual and physical order can transfer the experience of his own life and that of mankind to the next generation or to other people in his own generation in a fully valuable way. It is precisely pedagogues, who engage in educational activity in contact with people who are being educated, who must satisfy maximally high requirements with respect to their theoretical preparedness in philosophy, psychology and their own speciality. This theoretical preparedness is always, albeit with greater or lesser comprehension, interwoven with the basic principles of systems theory. The application of the relevant ideas in improving the way in which educational content is organized is a key at this time. The establishment of new, modern educational subjects should be based on four basic principles which, taken together, ensure not only the internal systematization of each educational subject, but also the establishment of systemically organized educational programs.

Principle No 1

UNITY of PHILOSOPHY and PSYCHOLOGY (Φ & Ψ)

The **first basic principle** emphasizes the philosophical and psychological aspect of education, and this must be the foundation for every educational subject that is established. Only if we always and everywhere see the relationships between man and the world as clearly and generally as possible can we reveal the various specific relationships of people and their world within the context of an educational subject. A general orientation in this idea can be assisted by the next chart.



The material background of human life

The world is a set of diverse phenomena, and each human is one of them. Humans reflect the world in their consciousness by parts, comparing and connecting them -- *cognition* serves as basis for *consideration*, consideration initiates *behavior*. Reflection of sensed life phenomena are a unity of material or substantial and spiritual or informational activities.

The principle of the unity of philosophy and psychology acts like a backbone for a general understanding of three fundamental qualities of modern life and education, as follows:

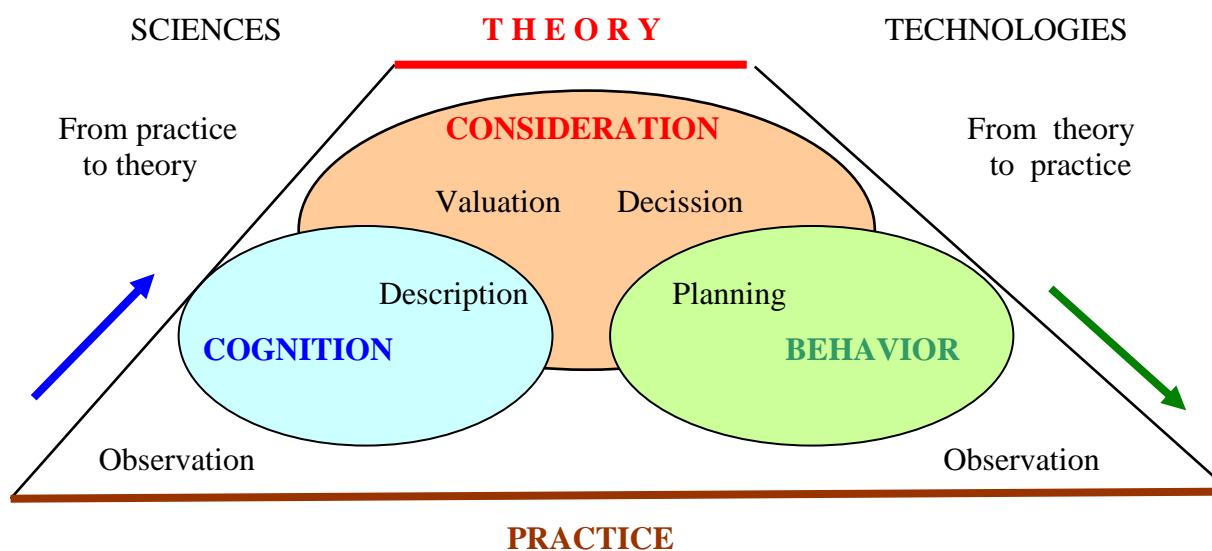
- **COMPLEXITY** of worldwide phenomena - diversity and speed, globalization and polarization - has become the main characteristic of our lives today;
- **SCIENTIFIC and TECHNOLOGICAL PROGRESS** is the main origin (cause) of the remarkable changes (reforms and transformations) which are occurring in our lives today;
- **HUMANIZATION** is becoming the main goal of general education for the future development of our lives today.

Principle No 2

UNITY of THEORY and PRACTICE (T & P)

The **second basic principle** is related to the universal cycle of human activity – cognition, consciousness, behavior – and the observance of this cycle in both the planning and in the implementation of pedagogical activities, as well as in the assessment of achievements. The following figure illustrates this laconically, clearly and exhaustively.

The structure of the universal cycle of human activity



SCIENTIFIC AND ARTISTIC **COGNITION** OF LIFE THROUGH EDUCATIONAL ACTIVITY LEADS TO THEORETICAL **CONSIDERATION** OF LIFE, AND THIS, IN TURN, DETERMINES THE **BEHAVIOUR** OF HUMANS IN THEIR PRACTICAL LIFE.

Principle No 3

UNITY of INTELLECT and MORALS (I & M)

The **third basic principle** is related to fundamental structure as the set of major goals that are involved in educational activity. In Latvia, this system of goals is set out in normative documents, including the overall Latvian educational concept, the new (approved in 1998) law on education, and various working documents such as Latvia's basic educational standards and others.

The system of overall goals in Latvia's educational activities (i.e., both teaching and upbringing) includes aspects of educational content and levels of education, and the systemic unity of these aspects determines the quality of one's educatedness.

The general structure of the content of educatedness

Upbringing -- MORALS				
Good will, respect, love				
	KNOWLEDGE (cognition)	ATTITUDES (consideration)	SKILLS (behavior)	
SCIENCES (mind , notions)	*	*	*	THE TRUE
ARTS (feelings , images)	*	*	*	THE BEAUTIFUL
TECHNOLOGIES (will , needs)			*	THE USEFULL
Learning -- INTELLECT				
Usefulness, applicability				

Life skills – the result of finally planned, achieved and evaluated educational activities.

Principle No 4

UNITY of FACTOLOGY and CAUSALITY (F & C)

Finally, the **fourth basic principle** accents the full implementation of an education of scientific nature. This is particularly important today, when the technological environment around us is expanding. A sensible life in the 21st century will require specific attention to the causes and consequences of the phenomena of the world and the responsible use of them. In pedagogic work, parallel to artistic feelings there must be developed a clear scientific or rational view of the world, one which ensures an appropriate look at the phenomena that are under review, both in terms of initially noted facts and descriptions and in terms of an explanation of the causes of the facts and the relationships between those causes and their consequences. The statics and kinetics of various phenomena should be separated out from the beginning, so that in their overall synthesis there might be as much clarity as possible about the elementary conditions of the relevant system. The main thing is to help the people who are being educated **to develop their creative thought**, and this has to do with the aforementioned cognition-consideration-behavior cycle, rising above a simple memorization and reproductive use of facts. In this sense pedagogues could use the following system of concepts about the systemic research of the wide variety of phenomena.

Factological and causal levels of human's consciousness

	Equilibrium states STATICS	Nonequilibrium states KINETICS	
FACTOLOGY (What, when, where, how?)	This , then, there in that way was, is !	This , then, there and in that way was, is changing !	Macro investigation
			Micro investigation
CAUSALITY (Why this, then, there in that way?) <i>Dynamics, energetics</i>	This , then, there in that way was, is , will be because	This , then, there and in that way was, is , will be changing, because ...	Macro investigation (Horizontal causality)
			Micro investigation (Vertical causality)

7. CONCLUSION

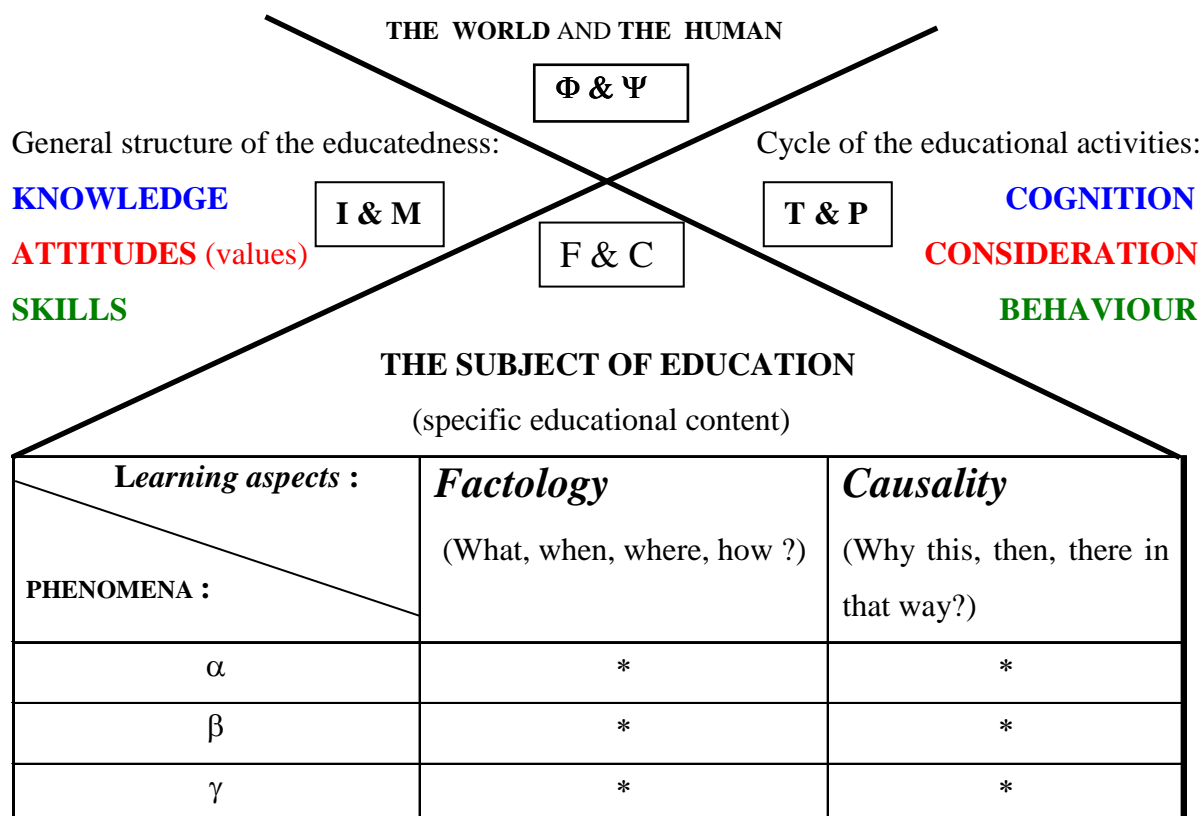
In conclusion, let us correlate all of what has been said here in relation to the work of educators in the shaping of modern educational subjects in a systemic way. All of the individual aspects of systems theory, systemology of education and pedagogy which have been reviewed in this article and the relationships among them represent a system which is of particular use right now in the systemic structuring of new educational content in the educational subjects that are of importance at the beginning of the 21st century. It seems that this is the best characterization of the use of systems theory in educational (management of education and pedagogical work) – demonstrating itself in a concrete, practical situation.

Let us seek out the natural arrangement of things and processes, let us locate causes and relationships therein, information starts with our senses, etc. – these are classical pedagogical ideas which have been expressed by numerous authors of educational systems. In all of these ideas we find the implementation of the basic ideas of modern systems theory, with eternal truths finding modern expression under the conditions of the specific time that is at hand. For that reason, **it is very important at this time to review the collections of fundamental ideas again and again, so as to ensure that the values which are contained therein might be used as effectively and usefully as possible under the conditions of our modern lives.** Systems theory not only unifies and orders the classics, giving them modern forms, but it also relates the comparatively eternal to the timely issues of the day. You, dear reader, should also be a fully valuable system among other systems. Establish your systems. Participate in other systems. Understand yourself to be the cause and consequence of other world phenomena.

May we have a successful 21st century in our creative educational work.

The system of general guidelines for the establishment of educational content in educational subjects are demonstrated in the following final figure.

General systemic guidelines for the establishment of the content of an educational subject



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ONTODIDACTICS WITHIN THE DEVELOPMENT OF MODERN NATURAL SCIENCE AND TECHNOLOGY EDUCATION

Article published:

A.Broks. ONTODIDACTICS WITHIN THE DEVELOPMENT OF MODERN NATURAL SCIENCE AND TECHNOLOGY EDUCATION. – Proceedings of 7th IOSTE Symposium for Central and Eastern Europe „Science and Technology Education in Central and Eastern Europe: Past, Present and Future”, Siauliai, Lithuania. – Siauliai University Publishing House, 2009 (pp.31 – 35).

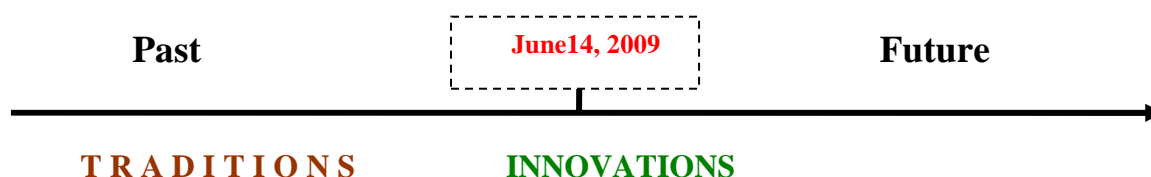
1. Introduction: traditions and innovations

This is not typical research paper with corresponding formal structure because it's prepared to continue presentation of author's ideas in English to our Western as well as other post-soviet colleagues in Eastern Europe (Broks, 2002;2005;2007;2008).

Now it's time again of serious changes in our life and education. For many people and countries now there are changes within changes, what means complex overlapping of local and global political and economical changes.

Scheme No 1

Modern innovations – bridges to our future life and education



To meet these changes and to solve coming new problems there is an actual need to increase **effectiveness** of NSTE. We need appropriate development - innovations in corresponding subject Didactics and Pedagogy, we need taking away traditional isolating gaps between different branches, stages and kinds of education. Special accent has to be made on General Science Education as fundamental background of modern professional Science and Technologies Education (NSTE) as well as of modern General Education for all. Need for modern content of NSTE today is becoming of special actuality because of rapid development of e-education technologies within modern pedagogy of NSTE.

Systemic concept of *Education as a specially organized gaining of life experience for life* has been discussed in author's previous IOSTE symposium report (Broks, 2007). There were three general components of our educatedness as main characteristics of human's life experience: *knowledge, skills and attitudes*. Humans gain life experience part by part, comparing and connecting these parts: *cognition* is the background for *consideration*, which, in turn, is the basis for purposeful *behavior*.

Systemic relations between modern Science, Technology and Education as well as General and Professional NSTE has been discussed last year in Krakow (Broks, 2008). Traditionally in our school systems Professional NSTE is dominating and today this is one of the points why do we need serious improvement - development of modern General NSTE. Therefore it is actual to pay special attention to principal difference in understanding concept "didactics" by professional scientists/engineers and science educators – in professional NSTE this concept traditionally is understood only as content and methodology of corresponding Science and/or Technology itself.

2. Didactics and Pedagogy within general structure of NSTE

Today for innovative development of NSTE we need much broader approach to traditional concept of Education in general and particularly to traditional concepts of Didactics and Pedagogy.

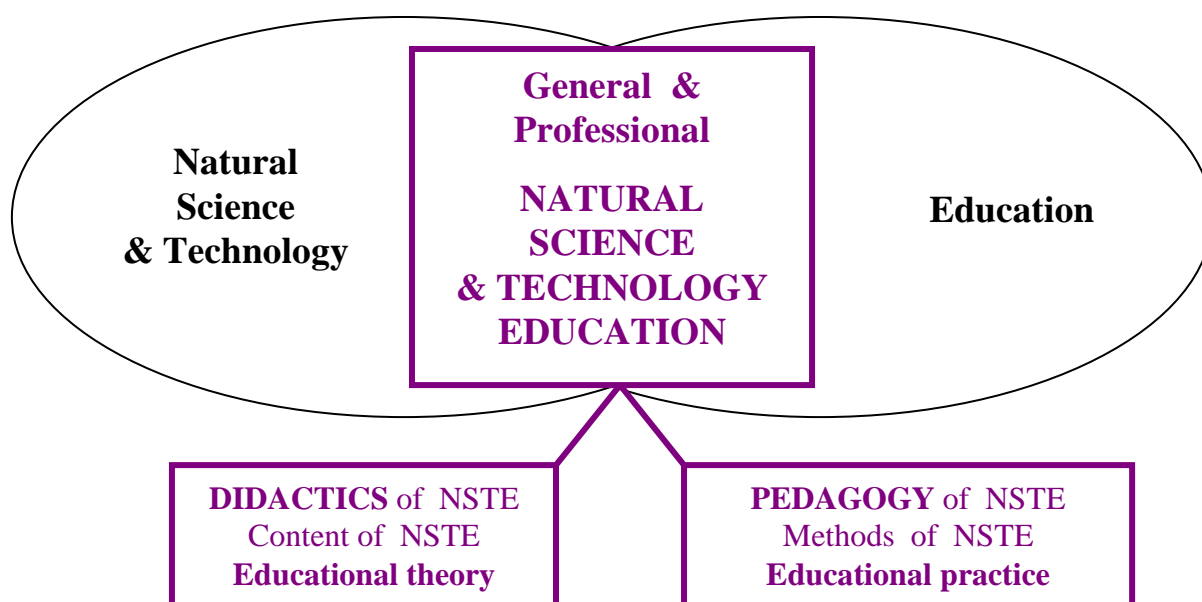
Subject **Didactics** (Physics Didactics, Chemistry Didactics etc.) today – it's the theory of educational content what arises from appropriate branch of science and/or technology. **What and why** to realize in corresponding educational process as a whole – these are two basic questions in didactics. Content of education determines goals, aims, tasks and objectives to follow in pedagogy. Didactics have to provide definite guidelines for educational practice – pedagogy, what includes also purposeful content of educational programs (curricula).

Subject **Pedagogy** (Physics Pedagogy, Chemistry Pedagogy etc.) today – it's the practice of implementing educational content in pedagogical process. **How** to realize given content of education - it's the only one basic question in pedagogy today. Pedagogy has fundamental connection with psychology because educational process involves creative interaction of teachers and scholars as humans.

For successful development of modern NSTE today we need **systemic overlapping** of modern Science and Technology content and methodology with general concepts and structures of modern Education.

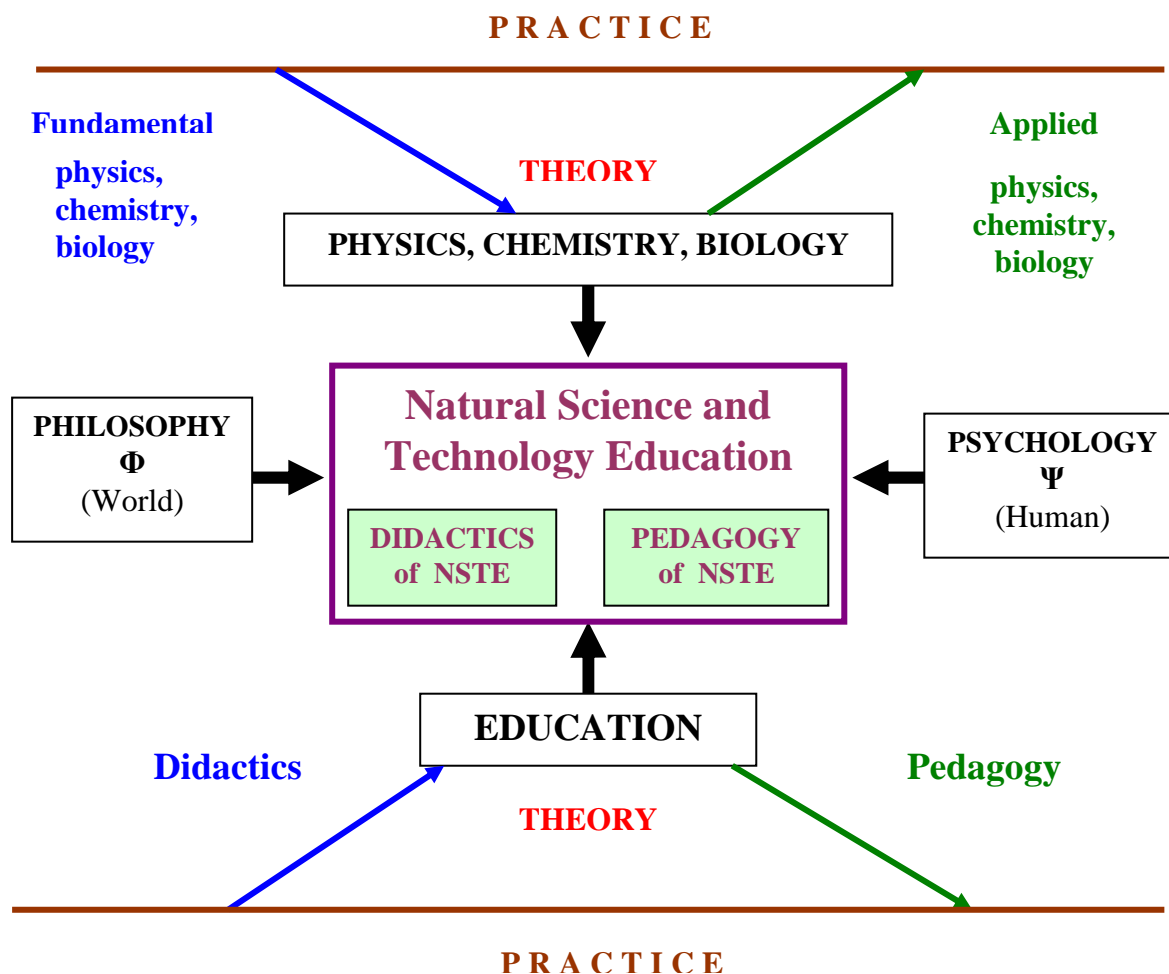
Scheme No 2

Genesis of Natural Science and Technology Education



Didactics and Pedagogy of NSTE within a more detailed environment of fundamental and applied science, theory and practice, philosophy and psychology are presented in scheme No3.

Detailed environment of Natural Science and Technology



Finally, there are two systemic innovations within traditional terminology. Firstly, term “education” is interpreted as more general term what includes terms “didactics” and “pedagogy”. Secondly, term “didactics” is used in the meaning of the theory of educational content, but term “pedagogy” corresponds to practical realization of given educational content. Didactics as the theory of education starts from life practice, but pedagogy serves to bring back given educational content into corresponding life practice. In other words, today with account of increasing complexity of our modern life, search for the answer to the question “what education (life experience) for what life?” brought modern Didactics out of traditional Pedagogy.

In according to develop innovations in Didactics the term “ontodidactics” as innovative didactics has been renovated (Broks, Voitkans, 2006). Origins for such renovation go back to author’s doctoral studies when he has studied not only solid state physics but also actual problems of higher education didactics (Sokolovskis, 1973). Another impact came from original General Physics courses of R.Feynman and his suggestions how we can improve our Science education (Feynman, 1968).

3. Ontodidactics as innovative approach within modern NSTE

There are two fundamental branches of innovations in modern NSTE. These are innovations in Didactics (ontodidactics as development of new educational content) and innovations in Pedagogy (implementation of e-education technologies in pedagogical process).

With account of general and professional education the scheme No4 has been developed to visualize interrelations of corresponding terms.

Scheme No 4

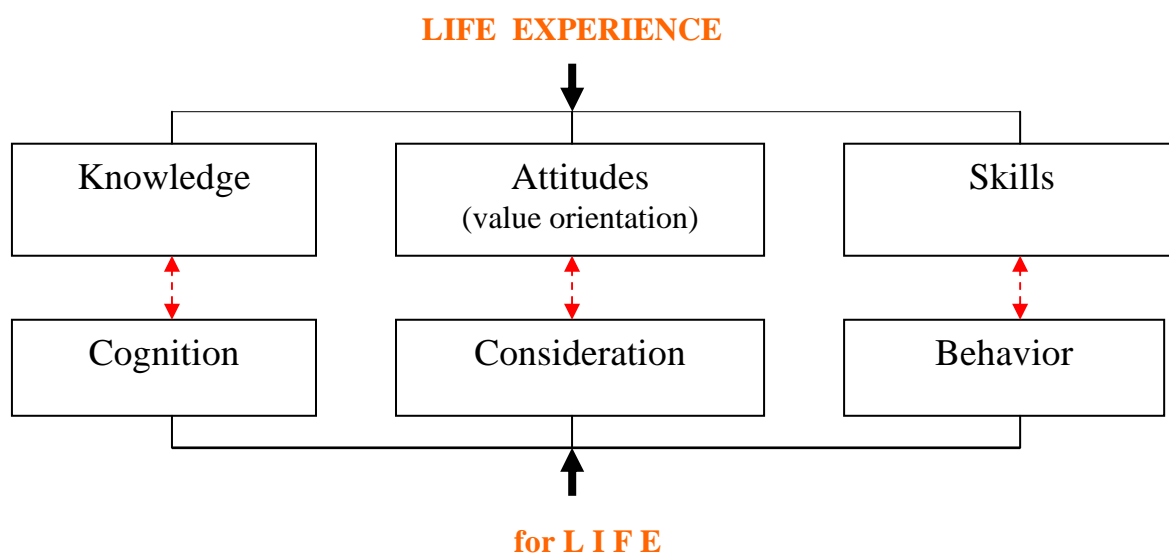
General map for orientation in research and development of NSTE

N S T E		Traditional	I n n o v a t i v e
General	Didactics		Ontodidactics
	Pedagogy		e-education technologies
Professional	Didactics		Ontodidactics
	Pedagogy		e-education technologies

According to author's proposed version innovative development of modern educational content - ontodidactics starts with already mentioned extended systemic definition of education as **life experience** (knowledge, attitudes, skills) **for life** (cognition, consideration, behavior) (Broks, 2007). Today we need much more opened as traditional NSTE approach for modern development of General NSTE, integration with modern innovative educational theories has become very important.

Scheme No 5

Principial structure of modern educational content



There are three main aspects of the following development of corresponding NSTE ontodidactics. According to scheme No5 they deal with three systemic (interrelated) modules which are representing connections of cognition process with gained knowledge, consideration process with formed attitudes and behavior process with developed skills.

First aspect deals with reconstruction of “knowledge – cognition” module of modern NSTE.

This is very traditional and basic module of human’s life experience for life. The problem is that today we have gathered tremendous amount of information and it is very important to select only this part of it what do we need to turn in definite human’s personal knowledge. **What knowledge for what life?** – this question has become of special interest. What information is needed today – answering this question we can select appropriate information for transformation into corresponding knowledge.

Along with the task to select appropriate information for including in corresponding educational programs (curricula) there is another very actual problem – we need to develop **modern arrangement or classifications of already existing knowledge**. We need to build systems of knowledge in order to be able to manage corresponding information resources. We need serious innovation of educational materials (books, internet resources etc.) what again means innovative – ontodidactic approach to the content of modern education.

In other words, education starts from gaining corresponding knowledge. There are serious problems today due to information explosion, but in general it is not enough for life practice to have only knowledge. Knowledge makes only one part of life experience for life.

Second aspect deals with the development of “attitudes – consideration” module within modern NSTE.

It’s well known, that finally we need to develop corresponding skills for different applications of gained knowledge. It’s truth, but before we use some definite knowledge, we need to evaluate this usage - is it good to realize this application of given knowledge in real life. This aspect is not very clear discussed and developed in traditional Western education.

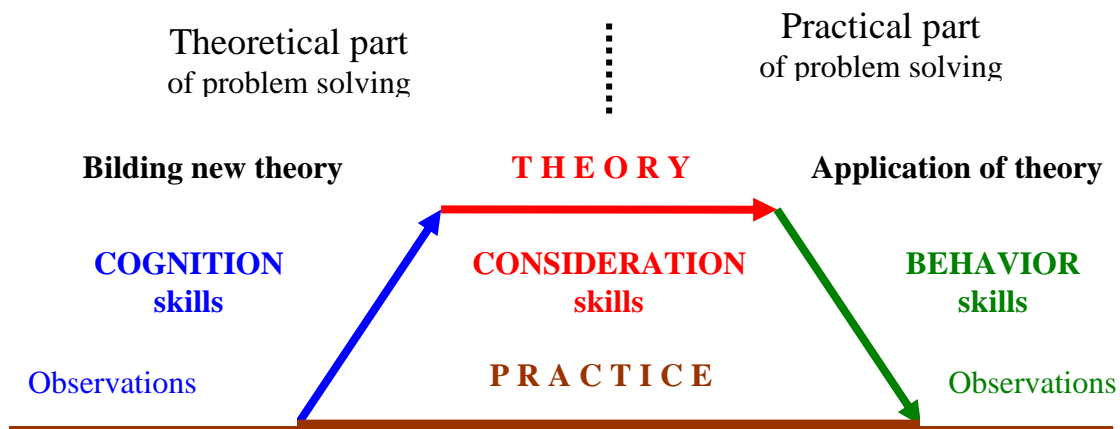
Development of **value orientation** is very important within the development of modern General Education and particularly General NSTE. Development of value orientation abilities (including self-evaluation and other kinds of valuations) is becoming more and more actual because there is serious need to increase individual as well as collective responsibility of modern people when living modern life. It becomes a fundamental part also within modern NSTE. Traditional attitude towards such unpopular term as “upbringing” along with popular terms “teaching”, “learning” has already generated many unwanted problems today.

Third aspect deals with innovative development of “skills – behavior” module of modern NSTE.

It’s concerned with well known but usually not completely realized in practice statement that most valuable life experience for life is **a general set of problem solving skills**. Problem solving as a typical our life process means more or less independent and creative (constructive) search for prior unavailable life experience or new application of already existing life experience on the way to satisfy some actual human’s life need. The process of gaining appropriate problem solving skills during pedagogical process today is well known as “constructivist approach” and corresponding pedagogical methodology is called “constructivism”.

According to the universal structure of human’s purposeful actions or life fractal “cognition-consideration-behavior” all problem solving processes have the same universal structure (Broks, 2005). Therefore it becomes clear what are the fundamental problem solving skills which have to be developed. They form a system of skills what includes **cognition skills**, **consideration skills** and **behavior skills** (scheme No5).

Problem solving skills as the set of fundamental life skills

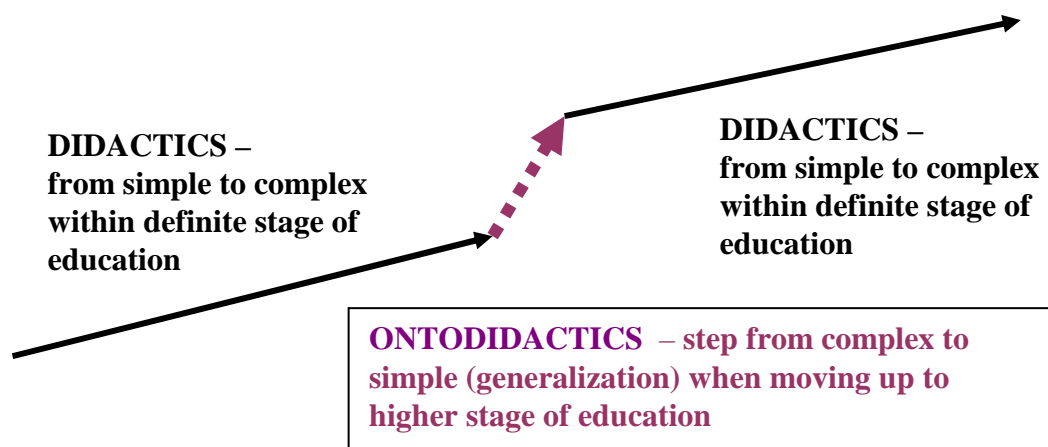


Problem solving skills are universal systemic – interrelated skills within the frame of General Education as well as General NSTE.

By the way, constructivism in modern pedagogy can be viewed as theory what includes earlier developed behaviorism and cognitivism.

Finally there is one more very important aspect for the development of ontodidactics. It deals with corresponding reconstruction of a given educational content according to the principle “**from complex to simple**”, when moving up to higher level of generalization as well as abstraction. It’s taking place always when we are moving up to higher stage of education (from preschool to primary – secondary (lower, upper) - tertiary stages of educational systems). Definite attempt to start realization of this principle has been made in our latest research activities (Broks,Voitkans 2006;2007,2009).

Multilevel structure of NSTE – unity of didactics and ontodidactics



Conclusions

When we are looking for higher effectiveness of our education the need for serious changes (transformations) within traditional content and methods of NSTE has become of great importance. Development of ontodidactics as well as e-education technologies are of special interest.

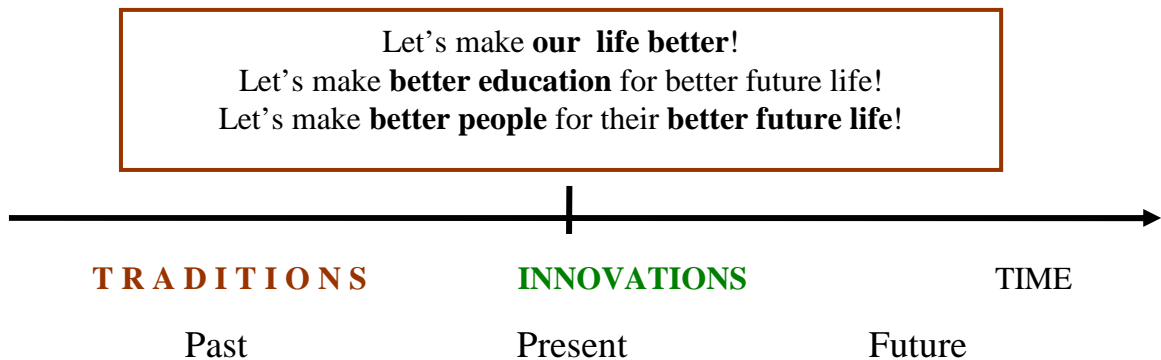
At the same time it's actual to make a note that traditions are very strong and innovative approaches are not popular. Observing very fast changes of our life today, it seems that getting answer to the question "what education (life experience) for what life?" has to be delegated to the next generations of educators. Older generation has to help them with their fundamental experience. Ontodidactics is just one area for corresponding cooperation of old and new generations of educators.

Finally there is an **overall task** for all coming generations and all kinds of innovative development of education – **purposeful development of humans' systems thinking**. All provided in this article schemes demonstrate definite structures of corresponding concepts and serve as definite projects' maps – technical drawings for realization of these innovative structures in real practice. But first we need to prepare people to understand these drawings on the basis of their systemic competence in modern life and education. Usually it's not the appropriate task for ordinary representatives of traditional pedagogy today.

Development of SISTEMOLOGY OF EDUCATION (Broks, 1999; 2001) as applied systems theory in education has to be understood theoretically and then realized in practice.

Scheme No 8

Let us work for better life and education in our future !



Finally let us repeat once again: **the one who changes** in accordance with the progressive development of things and processes in the world today **will survive and live better**. Innovative partnership of existing old and new coming generations of educators will help to solve modern complex problems of our education.

Good luck to all of us!

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