

Organizing of Independent Cognitive Activity of Teachers in the Context of Didactics and Neuroscience

Olena TONNE¹,
Olena VARETSKA²,
Olena KHAUSTOVA³,
Victoria TARASOVA⁴

¹ Municipal Institution «Zaporizhzhia Regional Institute of Continuing Pedagogical Education» of Zaporizhzhia Regional Council, Ukraine, center33nm@gmail.com

² Municipal Institution «Zaporizhzhia Regional Institute of Continuing Pedagogical Education» of Zaporizhzhia Regional Council, Ukraine, olena22varetska@gmail.com

³ Municipal Institution «Zaporizhzhia Regional Institute of Continuing Pedagogical Education» of Zaporizhzhia Regional Council, Ukraine, alenahau@gmail.com

⁴ Bogdan Khmelnytsky Melitopol State Pedagogical University, Ukraine, marsetka11@gmail.com

Abstract: *The article substantiates that in the context of organizing the independent cognitive activity of teachers in the post-Soviet space, the process of improving their qualifications, which takes place on the basis of their free choice of forms of education, programs and educational institutions, is of particular importance. At the heart of this choice, decision-making on independent cognitive activity and emotional-motivational resource are not only external stimuli, but also neurophysiological and psychological mechanisms. The purpose of the study is a scientific substantiation of the necessary and sufficient psychological and pedagogical conditions and models of organization of independent cognitive activity of teachers of secondary schools in the process of competence development. The analysis of the experimental data showed a noticeable difference between samples B3 and B4 at the end of the experiment for each of the defined criteria, as well as for the general indicator of the organizing of independent cognitive activity. The results obtained during the pedagogical experiment proved that the organizing of independent cognitive activity of teachers on the basis of the author's model helped to increase the effectiveness of this activity. During the discussion, it was proved that an important component of a person's professional training for any activity, especially in educational, is the development of neurophysiological and psychological potential for subjective self-determination of self-learning, self-improvement, and in micro-development - for independent choice and decision-making in a situation of cognitive or activity-related uncertainty. Therefore, decision-making is a basic component of any constructive activity.*

Keywords: *psychological and pedagogical conditions; andragogic process; neuroscience; author's model; postgraduate education institutions.*

How to cite: Tonne, O., Varetska, O., Khaustova, O., & Tarasova, V. (2021). Organizing of Independent Cognitive Activity of Teachers in the Context of Didactics and Neuroscience. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 12(2), 139-160.

<https://doi.org/10.18662/brain/12.2/197>

Introduction

Today, the strategic task of the post-Soviet states in the field of education is to create a new cultural and educational space through the development and implementation of state standards of general secondary education, standard curricula and study programs for primary, basic and high schools.

The success of the reform depends on the extent to which secondary school teachers meet the new requirements of professional activity, according to which they should not be executors of regulated actions aimed at forming students' abstract knowledge in a particular subject, but creative subjects who form, in addition to knowledge, stable skills and creative attitude to the world around.

Since any educational or cognitive process involves the modification or creation of neural connections for a new model of thinking and behavior, the nature of the teacher's self-educational activities can be holistically objectified only taking into account the data of neuropsychology and neuropedagogy. In addition, human subjectivity is one of the main biosocial functions that are determined neurophysiologically and are of exceptional importance in educational and self-educational activities.

In the context of the organizing of independent cognitive activity of teachers, the process of raising their competence, which takes place on the basis of their free choice of forms of education, programs and educational institutions, acquires special significance. The problem of choosing, making behavioral and activity decisions on self-development is based on natural and acquired neural connections, which is psychologically manifested in the sense of meaning, motivation and emotional and volitional qualities of the teacher.

Preliminary analysis of the experience of in-service training of teachers in institutions of postgraduate pedagogical education allows us to state that the organization of their independent cognitive activity has a number of shortcomings. In particular, it is the lack of motivational, bright guidelines for such activities for students of advanced training courses, imperfect mastery of information technology by teachers, lack of order in the exchange of electronic information between the subjects of the andragogy process, etc. Hypothetically, the main problem lies in the imperfection of the process of professional development, which does not arouse interest, motivation and vivid emotions in educational entities with already firmly established neural connections and responsible professional competencies.

Li, Gow, & Zhou (2018) proved the key role of emotions in cognitive activity and education. According to these authors, in didactics, unfairly little attention is paid to the emotional component, which is actually the most important educational condition. Emotions affect attention, memory and motivation, and as a result – academic results (Li et al., 2018). Based on the fact of the presence of emotional-cognitive brain mechanisms, a direct relationship between the nature of emotions and the quality of cognitive processes has been established, which should form the basis for creating more positive learning environments in educational institutions.

Overcoming shortcomings by institutions of postgraduate pedagogical education is associated with the purposeful improvement of the content of regulatory documentation, methodological support of the process of teacher training. However, in this way there are a number of contradictions, in particular between:

- socially conditioned need for permanent internally motivated increase of the level of professional competence of teachers during life and their lack of personal motivation to improve the quality of their professional activity;

- the realities of professional activity, which require a high level of cognitive activity and independence of the teacher, due to the constant need for new information that arises in the context of professional situations, and traditions of postgraduate pedagogical education, according to which students' assimilation of information is passive and dependent on external stimuli nature (activity in response to managerial actions of andragogues);

- the importance of independent work of teachers for the formation of professional subjectivity and the insufficient level of its methodological support in advanced training courses and in the inter-certification period.

The basis for resolving these contradictions is laid in scientific works devoted to the development of the theory of adult education (Jarvis, 2004; Sysoyeva, 2011), as well as theoretical and methodological foundations of postgraduate pedagogical education (Gerasymova et al., 2019; Kovalchuk, 2014; Kuzminsky, 2003; Nerubasska & Maksymchuk, 2020; Nychkalo, 2009; Kaletnik et al., 2011; Oliynyk, 2015; Melnyk et al., 2019; Sheremet et al., 2019; Onishchuk et al., 2020; Maksymchuk et al., 2020). The works of these authors substantiate the conceptual foundations of postgraduate education of teachers, as well as lay the foundation for improving the algorithms for organizing their independent cognitive activity in the process of competence development.

Ideas on the essence of independent cognitive activity and mechanisms of its organizing in applicants for higher pedagogical education

are presented in the works of Korohod (2013), Pereyaslavskaya (2011), Ryabchenko (2011), Soldatenko (2012). Useful in the context of this study, the proposals are presented in publications that highlight the organization of independent cognitive activity of students of secondary schools (Genkal, 2008; Savosh, 2017). Promising ideas are offered in the researches devoted to preparation of future teachers for the organizing of independent cognitive activity of pupils (Kovtonyuk, 2013). A review of sources on this issue gives grounds to state that today scientists have substantiated and experimentally tested the pedagogical conditions for the organization of independent cognitive activity of subjects of study in general and higher education. The scientific works describe the issue of andragogical stimulation of professional self-improvement of teachers in the process of postgraduate education, but there is no analysis of the organization of independent cognitive activity of secondary school teachers as a system of orderly actions on advanced training courses and in the inter-certification period, directed on processing by them of various information sources, generalization of results of this work with the subsequent objectification in professional activity.

In fact, neuropedagogical and neuropsychological aspects of the problems of educational motivation and independent educational activity began to be actively developed only in the late 1990s - early 2000s. Neuropsychologists have now shown that all participants in the educational process are by nature subjects in which social, psychological, and neurophysiological mechanisms act simultaneously in the direction of self-creation, Della Sala, & Anderson (2012). Therefore, the neuroscientific approach involves the use of methods of humanities and natural sciences and the expansion of interdisciplinary terminology.

Neuroscience is currently studying a person's self-control in connection with his personal activities and social behavior (Bagozzi & Lee, 2017), the neurophysiological nature of the influence of social factors (fashion, advertising, brands) on unconscious behavior and decision-making (Camerer & Yoon, 2015). Neurophysiology also studies changes in activity and behavior (dependent, compulsive, deviant) due to pathology. The neurophysiological nature of the correlation of thinking, memory, motivation and activity as a result of personal decision-making is directly related to the independent cognitive activity of teachers (Baddeley, 2017).

The purpose of the study - scientific substantiation of the necessary and sufficient pedagogical conditions and models of organization of independent cognitive activity of teachers of secondary schools in the process of

professional development based on neurophysiological mechanisms of motivation, choice (forms of independent activity) and decision making.

Materials and methods

Hypothetically valid psychological and pedagogical conditions in the experiment were developed based on neuropsychological principles, which are based on subjectivity, interaction, emotional coloring. They chose the principles:

- the subjective role of a teacher of a secondary school, according to which, the management of independent cognitive activity is based on the subjective activity of students, their personal interest;
- feedback, which is that the teacher should receive a reaction to the results of their independent cognitive activity from teachers and tutors of the institution of advanced training, and andragogues should constantly receive information about this activity from students;
- pragmatism, according to which, independent cognitive activity should be aimed at solving real problems of professional activity of teachers and promote the fastest use of knowledge and skills acquired during training;
- consistency of emotional, cognitive and practical components of the joint activities of andragogues and teachers, according to which, the actions of andragogues should be subject to the rule "heart-head-hand". In other words, the organizing of independent cognitive activity of teachers must go through stages: "feelings", "awareness" and "practical actions".

Based on the above principles, a number of educational and psychological conditions for building an andragogical process based on the author's model of organization of independent cognitive activity, which integrates normative-target, procedural and effective blocks, were chosen.

The conditions were subject to experimental verification, the provision of which, hypothetically, should increase the effectiveness of the organization of independent cognitive activity, namely:

- selection of independent cognitive activity of teachers in the certification process as an indicator of the success of their professional development;
- motivating teachers to independent cognitive activity;
- directing the content of refresher courses and short-term formal and informal types of andragogical interaction to teach teachers the basics of organizing independent cognitive activity;
- step-by-step methodical support of independent cognitive activity in the inter-certification period;

- supplementation of certification measures with recommendations for teachers for the next cycle of competence development on the organizing of their independent cognitive activity.

It is proved that the creation of these conditions in compliance with the principles described above becomes possible when building an andragogical process according to the author's model of organizing of independent cognitive activity, which integrates normative-target, procedural and effective blocks.

The normative-target block of the model reflects the links between public demand, multilevel normative documents, principles, conditions, as well as methodological support, which together determine the direction and regulate the organizing of independent cognitive activity of teachers in the process of competence development.

The procedural block of the model represents the gradual nature of the organizing of independent cognitive activity (hereinafter - ICA) of teachers.

The resulting block of the model reflects the links between the components of the author's idea regarding the end results of the andragogy process, as well as ways to record these results.

According to the model of organizing of independent cognitive activity of teachers in the process of competence development, this process integrates five stages, including:

- preparatory, the task of which is to develop and implement an algorithm for comprehensive assessment of professional activities of teachers in the inter-certification period, as well as training of andragogues to organize independent cognitive activity of teachers in the process of professional development;

- reflexive and stimulating, which involves strengthening the motivation of teachers to independent cognitive activity through the creation of reflective-stimulating environment;

- cognitive, the tasks of which are the objectification and development of cognitive-analytical properties of teachers, as well as training in their skills and algorithms for processing, changing, synthesis and presentation of information;

- distant and search, on which there is a movement of cognitive activity of teachers to perform specific methodological and scientific tasks;

- assessment and recommendation, which summarizes the five-year period of professional activity of the teacher in terms of independent cognitive activity, as well as provides recommendations for the next cycle of training.

At the pre-experimental stage, it is assumed that measuring the level of organization of independent cognitive activity will be informative, based on the following criteria:

- procedural, which allows to assess the information competence of the teacher as the ability to perform intellectual operations, as well as his computer literacy and inclusion in the network community;

- educational, aimed at assessing the intensity of self-educational activities of teachers in the inter-certification period (indicators of this criteria: advanced training in the main subject; specialization courses in additional subjects; obtaining a degree, title; obtaining a second higher education; postgraduate studies; participation in various forms educational activities);

- effective, which allows to evaluate the results obtained in the inter-certification period of scientific and methodological and research activities (indicators - the number of own methodological developments; the number of methodological developments in co-authorship; the number of published articles and abstracts; the presence of a personal site; the number of other prepared materials).

It is substantiated that the appropriate means of assessing the organizing of independent cognitive activity of teachers of secondary schools in the author's methodology are: test-questionnaire on information competence; self-assessment form by the teacher of the quality of independent cognitive activity. Qualimetric tool for assessing the quality of independent cognitive activity based on Excel. In this case, the organization of independent cognitive activity of teachers should be assessed at four levels, corresponding to a certain qualification category: low ("specialist"); basic ("specialist of the second category"); high ("specialist of the first category"); creative ("specialist of the highest category").

In the course of the pilot study the norms of the author's methodology were established, as well as its expediency and informativeness were tested. During the experiment, special attention was paid to identifying the characteristics of the teacher, which have a clear neuropsychological correlation: motivation, independence, position of choice, activity, creativity (non-standard problem solving).

To test the effectiveness of the model of organization of independent cognitive activity of teachers, an experiment was conducted, the duration of which is determined by the duration of the inter-certification period.

During the experiment, independent samples of teachers, similar in composition and structure were analyzed.

In particular, on the basis of certification lists, four samples were formed (B_1, B_2 - 2015 and B_3, B_4 - 2020), aligned by the frequency distribution of such features as: gender, age, subject taught, category. The number of teachers in each sample was the same - 25 people (7 men and 18 women). A total number of 100 teachers took part in the experiment, who improved their skills at the Zaporizhzhya Regional Institute of Postgraduate Pedagogical Education.

Appropriate means of assessing the organization of independent cognitive activity of teachers of secondary schools in the author's methodology were: test-questionnaire on information competence; self-assessment card by the teacher of the quality of independent cognitive activity.

At the beginning of the experiment, samples B_1 and B_2 included teachers, whose organizing of independent cognitive activity took place traditionally.

At the end of the experiment, sample B_4 differed from sample B_3 in that in the latter the organizing of independent cognitive activity of teachers took place in accordance with the model developed by us. The organizing of independent cognitive activity of B_3 teachers was carried out in the tradition of advanced training without the use of the author's theoretical and methodological achievements. The differences between these groups are due to: the amount of independent work aimed at organizing of independent cognitive activity in the inter-certification period (teachers B_3 had less than teachers B_4); the content of methodical work in this period (its volume and intensity in B_4 were higher).

The organizing of independent cognitive activity was measured during the certification of teachers. The first measurement was conducted in 2015/16; the second - in 2019/20.

Results

As a result of pre-experimental research and analysis of data from the formative-diagnostic experiment, the following generalized results were obtained:

1. The approval of a new format of professional activity of teachers is associated with their ability to continuous professional development, which is impossible without purposeful, orderly, intrinsically motivated independent cognitive activity, which allows them to respond to constant changes in content, technology, imperatives of teaching.

2. Direct responsibility for informational and motivational support for the professional development of teachers in general and their

independent cognitive activity in particular is overly relied by the state on the institutes of postgraduate pedagogical education, which are traditionally centers of advanced training, specialized training and retraining of teachers in the regions of the country.

3. The organization of independent cognitive activity of teachers in the process of professional development is at a low level. In particular, for refresher courses and methodological support of self-educational activities in the inter-certification period are characterized by superficiality and formality, which gives grounds for violation of the relevant scientific problem.

The data obtained in the experiment are shown in table. 1.

Table 1. *The level of organizing of independent cognitive activity of teachers in the process of competence development, % (systematized by the authors)*

Sample	Stage experiment	The level of organization of the ICA			
		Low	Standard	High	Creative
Procedural criteria					
B ₁	Beginning	8	52	36	4
B ₂	Beginning	20	48	28	4
B ₃	Ending	0	32	40	28
B ₄	Ending	8	48	36	8
Educational criteria					
B ₁	Beginning	48	40	8	4
B ₂	Beginning	56	28	12	4
B ₃	Ending	16	32	32	20
B ₄	Ending	44	40	8	8
Effective criteria					
B ₁	Beginning	4	76	16	4
B ₂	Beginning	0	68	32	0
B ₃	Ending	0	52	20	28
B ₄	Ending	4	64	20	12
Total					
B ₁	Beginning	24	48	28	0
B ₂	Beginning	28	52	20	0
B ₃	Ending	8	24	40	28
B ₄	Ending	20	48	28	4

Analysis of the data given in table. 1, showed:

- the absence of a significant difference in the organizing of independent cognitive activity of teachers by procedural, educational, performance criteria and general indicators at the beginning of the

experiment, which indicates the homogeneity of the contingent of samples B_1 and B_2 ;

- noticeable dynamics of the general indicator of the organizing of independent cognitive activity of teachers under the influence of introduction of author's model, and also dynamics of organizing of independent cognitive activity on each of the defined criteria;

- a noticeable difference between samples B_3 and B_4 at the end of the experiment for each of the defined criteria, as well as for the general indicator of the organizing of independent cognitive activity.

In addition, the comparison of the general indicator of the organizing of independent cognitive activity in B_1 and B_2 at the beginning of the experiment, (2013) according to the Mann – Whitney test did not reveal significant differences in the level of significance ($p < 0.05$).

Thus, the experimental study proved that the organizing of independent cognitive activity of teachers on the basis of the author's model helps to increase the effectiveness of this activity.

Discussion

Today, the organizing of cognitive activity of teachers by the system of domestic postgraduate pedagogical education in the post-Soviet space is provided by the following activities: advanced training, short-term training (conferences, trainings, seminars, meetings, master classes, etc.). Traditionally, in the system of management of postgraduate pedagogical education the key factor in the organizing of independent cognitive activity of teachers is the next certification. Unfortunately, subjective self-organization by teachers of their cognitive activity, the results of which are reflected in educational, methodical, scientific work, is considered secondary and is organized without taking into account neuropsychological factors.

The article proves that independent work, compared to organized from the outside, especially mobilizes the neuropsychological potential of man, as it forces him to make choices and make non-standard decisions in uncertain conditions. The neurophysiological mechanisms of such aspects of independent work (as well as independent learning) were elucidated at the beginning of the third millennium and made them an interdisciplinary object of study (Kahneman & Tversky, 2000). Neuropsychological relevant characteristics of independent decision-making and choice are adequacy, time consumption (time deficit, deadline), uncertainty of markers, responsibility, heterogeneity of selection criteria. All these parameters are associated with the activation of neuropsychiatric mechanisms of subjectivity.

After analyzing the relevant sources and checking the author's model of the organization of the independent cognitive activity of teachers in the course of professional development, it became clear that independent cognitive activity has a common neurophysiological and individual psychological nature and is conditioned by the interests, motives and desires of a person, the consequence of which is the acquisition of knowledge about the objective and subjective reality. It is a sequence of conscious, freely chosen, internally motivated cognitive operations and objective actions aimed at forming in the mind of the subject of certain images through the processing of information sources, communication, and generalization of their own and others' experiences.

It is substantiated that the impact on the quality of cognitive activity of teachers should be denoted by the conceptual construct "organizing of independent cognitive activity", which means the system of actions of postgraduate pedagogical education to regulate the interaction between andragogues, students and other components of the andragogical system, development of their cognitive-operational competencies in order to systematically improve the quality and effectiveness of professional activities.

Observations and experimental testing have shown that independent cognitive and educational activities of professionals (self-education, training, improvement) are associated with neuropsychological motivational mechanisms, self-reflection and individual professionally oriented qualities. Based on these psychological and neurophysiological factors, it is necessary to transform the distance learning process of the XXI century on the basis of creativity and innovation. This will provide a closed system of self-educational activities at all levels: "In order for the education system to ensure purposeful and effective acquisition of students' self-education skills, it is necessary to promote the motivation and skills of teachers' self-education in the learning process, and thus improve the form of pedagogical competencies of students during the university process" (Samuseviča & Striguna, 2017).

It is determined that the theoretical basis for the organization of independent cognitive activity in institutions of pedagogical training, in addition to taking into account the neurophysiological basis, is the provision: humanistic psychology and pedagogy, relating to independence as an attribute of a mature person and a tool for its formation as a social subject; epistemology for understanding the processes of cognition as a function of the higher nervous system associated with figurative thinking; activity approach, which allows to consider independent cognitive activity as a sequence of conscious actions aimed at achieving a specific professional

result; socio-cognitive theory of Bandura (1986) that an effective factor in the professional development of teachers is the need to resolve the contradictions between the current state of personal development and the requirements of the social (professional) environment, which are growing; reflective approach, according to which, the key to professional growth is based on daily practice, a continuous process of analysis by the subject of its activities, identifying problems and correcting shortcomings; andragogy that advanced training will be effective only in the case of interaction of the formed personalities of the andragogue and the teacher, in which they are adopted as subjects of professional activity; competence approach, which makes it possible to determine clear parameters of the end result of the andragogic process; pedagogical management, which allows to justify the need to adjustment the interaction between the subjects and components of the andragogical system in order to form in the imagination of teachers effective models of cognition.

Based on the analysis of scientific sources (Klyasen, 2014; Kravchenko, 2010; Kapustyan, 2012) it is proved that the provisions of the defined theoretical basis for improving the efficiency of independent cognitive activity of teachers are most fully realized in the experience gained by systems improving their skills outside of the post-Soviet countries.

In particular, in such countries as Great Britain, Canada, China, Germany, New Zealand, Poland, USA, Sweden, sufficient attention is paid to the organizing of independent cognitive activity of teachers, which takes place in an extensive and differentiated system of special institutions of postgraduate pedagogical education. Among the promising concepts of the organization of independent cognitive activity are the following: group training of teachers on the basis of schools without separation from the workplace; systematic implementation of measures to improve the information and communication competence of teachers on the basis of schools; providing each teacher with a personal computer in the workplace; creating conditions for professional interaction of teachers; encouraging teachers to achieve professional achievements, etc.

Study of scientific works, which outline some ideas for organizing independent cognitive activity of different categories of people who receive education in different specialties at different levels (Adamiv, 2002; Benera, 2003; Washchuk, 2001), testified that in the didactic experience of post-Soviet countries the traditional means of organizing independent cognitive activity are: communication in network professional communities with the use of information and communication technologies; verification and self-verification of cognitive achievements; pedagogical support and support of

independent cognitive activity; independent work with the subsequent presentation of its results; development of information competence; use of information technologies for the purpose of search, processing and systematization of professional information; stimulating reflection through methods of quasi-professional training; implementation of individual educational projects and educational modeling; organization of "success situations"; use of advanced learning methods, etc.

However, the identified areas for improving the effectiveness of independent cognitive activity of students do not take into account the neuropsychological specifics of andragogical interaction in the process of teacher training and do not cover all aspects of independent cognitive activity of formed individuals, which they are.

It is proved that in order to increase the level of educational services of postgraduate pedagogical education institutions of the post-Soviet countries, as well as the entry of the their system of postgraduate pedagogical education into the European educational space it is necessary to develop methodological bases for organizing independent cognitive activity of teachers in the process of professional development also to carry out their practical implementation.

The article confirms the possibility of optimizing educational conditions to improve the professional competencies of teachers by strengthening the neuropsychological mechanisms of motivation, emotional brightness and formation of culture and techniques of independent work, which has already been described in methodical works on culture of self-education (Culture of Self-education) (Dyganova & Yavgildina, 2016).

The scientific novelty of the obtained results is that:

- *for the first time* The neurophysiological and psychological-pedagogical factors of independent educational activity of teachers are theoretically substantiated, namely - consideration of motivational, emotional-volitional, reflexive and other subjective factors of decision-making, choice and organization of independent cognitive activity. Also, a model of organizing of independent cognitive activity of secondary school teachers was theoretically substantiated and developed, which reflects the purpose, tasks, psychological and pedagogical conditions, stages (preparatory, reflexive-stimulating, cognitive, distance-searching, assessment-recommendation) and expected result of andragogical activity ; the andragogical conditions of the organizing of independent cognitive activity (allocation of independent cognitive activity of teachers in the certification process as an indicator of success of their professional development; motivation of teachers to independent cognitive activity; direction of the

content of advanced training courses on training of teachers of organizing of independent cognitive activity; inter-certification period, supplementing certification activities by providing teachers with recommendations for the next cycle of professional development on the organizing of their independent cognitive activity); a method for assessing the organizing of independent cognitive activity of teachers has been developed;

- the definition of the construct “organizing of independent cognitive activity of teachers” *has been clarified*, according to which it is a system of postgraduate teacher education to adjustment the interaction between andragogams, students, and other components of the andragogical system aimed at increasing the intensity of teachers’ self-education, developing their cognitive-information competencies with the aim of systematically improving the quality and effectiveness of professional activities;

- the target orientations of the process of professional development of teachers of general educational institutions in the aspect of independent cognitive activity on the basis of the defined criteria (procedural, educational, effective) of its efficiency *are improved*;

The scientific provisions of neuropedagogy, pedagogical management, competence, andragogical and activity approaches in postgraduate education of teachers *have been further developed*.

The practical significance of the obtained results lies in the fact that the following teachers have been developed and implemented in the process of competence development:

- methodical seminar for andragogues, aimed at explaining the neurophysiological and psychological features of independent cognitive activity of students of advanced training courses, as well as coverage of methods of its activation and management;

- events aimed at stimulating the neurophysiological mechanisms of teachers' reflection by presenting the best examples of independent cognitive activity (seminars with doctors of sciences, "round tables");

- special course "Information competence of the teacher", the content of which involves the formation of students' advanced training courses, providing them with information about the sources of knowledge, methods of systematizing the results of independent cognitive activity, as well as computer testing of knowledge with analysis of its results;

- seminar for teachers on the use of educational platforms, individual digital devices and cloud technologies for cognitive purposes;

- methods of qualimetric assessment of the level of organizing of independent cognitive activity of teachers in the cycle of advanced training;

- methods of methodological support of independent cognitive activity of teachers in advanced training courses and in the inter-certification period.

Conclusions

The professional activity of teachers can meet the rapidly changing social requirements only in the case of constant internally motivated professional development, which has general neurophysiological and individual psychological preconditions. This process of teacher training today is characterized by superficiality and formality of the organization, which causes low efficiency of independent cognitive activity of teachers, as well as difficulties in trying to acquire new and improve existing competencies.

The study of authoritative sources on the neuropsychological and neurophysiological nature of independent activity allows us to distinguish general neurophysiological and individual (psychological, phenotypic) patterns. Among the general aspects of clarifying the neuropsychological picture of independent educational activity are the following:

1. Usefulness, definition of subjective meaning (value) in a new activity or its results.
2. Formation of individual (subjective) image of the process and result of decision-making (choice) in educational activities.
3. Personal arguments in favor of choosing a strategy.
4. Identification of external factors influencing the process (social environment, educational environment).
5. Internal factors (emotional and volitional characteristics of the individual, the ability to self-organize, proactivity, etc.).

One of the promising areas for improving the efficiency of independent cognitive activity of secondary school teachers in the process of competence development in the post-Soviet space is the development of appropriate principles, conditions and models, the implementation of which in practice will meet both public demands and needs of teachers.

Independent cognitive activity is defined as a sequence of conscious, freely chosen, internally motivated cognitive operations and objective actions aimed at forming certain images in the mind of the subject through the processing of information sources, communication, and generalization of their own and others' experiences. The organization of independent cognitive activity of teachers is considered as a system of actions of the institution of postgraduate pedagogical education to adjustment the interaction between andragogues, students and other components of the

andragogical system aimed at increasing the intensity of teachers' self-education, development of cognitive and operational competencies activities.

Theoretical principles of the organizing of independent cognitive activity of teachers in the process of competence development determine: the position of humanistic psychology; provisions of epistemology; Leontiev's (2005) theory of activity socio-cognitive theory of (Bandura, 1986); reflective approach in pedagogy; andragogy; competence approach in higher education; pedagogical management. The following principles are based on these theoretical principles: the subjective role of the teacher, feedback, pragmatism and coherence of the emotional, cognitive and practical components of the joint activities of andragogues and teachers.

These principles are embodied in the following conditions for the organizing of independent cognitive activity of teachers of secondary schools in the process of competence development: the allocation of independent cognitive activity of teachers in the certification process as an indicator of the success of their competence development; motivating teachers to independent cognitive activity; directing the content of advanced training courses and short-term formal and informal types of andragogical interaction to teach teachers the basics of organizing independent cognitive activity; step-by-step methodical support of independent cognitive activity in the inter-certification period; supplementation of certification measures with recommendations for teachers for the next cycle of competence development on the organizing of their independent cognitive activity.

The creation of these conditions is ensured by the introduction of a model of organizing of independent cognitive activity of teachers, which represents the content of the preparatory, reflexive-stimulating, cognitive, distance-searching, assessment-recommendatory stages. At the preparatory stage the algorithm of complex estimation of professional activity of the pedagogical worker in the inter-certification period is created, which is based on the indicators of efficiency of independent cognitive activity substantiated by the author. At the reflexive-stimulating stage, the motivation of teachers to independent cognitive activity is strengthened through the creation of a reflective environment, which allowed to realize their own positives and shortcomings in the aspect of independent cognitive activity, as well as to obtain results of independent cognition and use them in professional activities. At the cognitive stage there was an objectification and development of cognitive-analytical properties of teachers, as well as their improvement of techniques and algorithms for processing, changing, synthesis and presentation of information. The distance-searching stage is devoted to the direction of cognitive activity of teachers to perform specific

methodological and scientific tasks. At the assessment and recommendation stage, the results of the five-year period of professional activity of a teacher in terms of his independent cognitive activity are summed up, as well as recommendations are provided, focused on the next cycle of competence development.

Procedural, educational and effective criteria are the basis of the methodology for assessing the effectiveness of the organization of independent cognitive activity of teachers in the process of competence development. The procedural criterion makes it possible to assess the information competence of the teacher as the ability to perform intellectual operations, as well as his computer literacy and inclusion in the network community. Educational - aimed at assessing the intensity of self-educational activities of teachers in the inter-certification period. Effective - evaluates the results of scientific-methodical and research activities obtained in the inter-certification period.

A three-component diagnostic complex is based on certain criteria and indicators, which includes: a test-questionnaire on information competence; self-assessment form by the teacher of the quality of independent cognitive activity; qualimetric tool for assessing the quality of independent cognitive activity based on Excel.

The result of using the diagnostic complex is to determine the organizing of independent cognitive activity of teachers at low, standard, high and creative levels.

The experiment showed that the introduction of the author's model significantly affects the level of organizing of independent cognitive activity of teachers in the process of competence development. In particular, the obtained data show that at the beginning of the experiment, (2015) there were no differences between the level of organization of independent cognitive activity and the sample of teachers. At the same time, at the end of the experiment, (2020) in the sample of teachers whose in-service training was based on the use of author's methodological achievements, the level of organization of independent cognitive activity by all criteria, as well as the general indicator. This conclusion was confirmed by comparing the data in B_1 and B_2 at the beginning of the experiment, (2013) according to the Mann – Whitney test, which did not reveal significant differences in the level of significance ($p < 0.05$), as well as the comparison made at the end of the experiment, (2018), which indicated the presence of statistically significant differences between B_3 and B_4 at the accepted level of significance.

Thus, the results obtained during the pedagogical experiment proved that the organizing of independent cognitive activity of teachers on the basis of the author's model helped to increase the effectiveness of this activity.

The study does not cover all aspects of the problem of organizing independent cognitive activity of teachers of secondary schools in the process of competence development. We see prospects for further research in the scientific substantiation of methods of organizing independent cognitive activities related to the use of individual digital devices. In addition, we consider it expedient and timely to create a common electronic database of individual trajectories of professional development of teachers.

References

- Adamiv, G. S. (2002). *Formuvannya u studentiv pedabohichnobo uchylyshcha piznavalnoyi samostiynosti (na materialy vnychennya psykholoho-pedabohichnykh dystsyplin)* [Formation of students of pedagogical school of cognitive independence (on the material of studying of psychological and pedagogical disciplines)]. [Abstract of PhD thesis]. M. P. Drahomanov National Pedagogical University, Kyiv. <http://www.lib.ua-ru.net/diss/cont/35568.html>
- Baddeley, A. (2017). *Working memory, thought, and action*. Oxford, UK: Oxford University Press. <https://oxford.universitypressscholarship.com/view/10.1093/acprof:oso/9780198528012.001.0001/acprof-9780198528012>
- Bagozzi, R. P., & Lee, N. (2017). Philosophical foundations of neuroscience in organizational research: functional and nonfunctional approaches. *Organizational Research Methods*, 22(1), 299–331. <https://doi.org/10.1177/1094428117697042>
- Bandura, A., (1986). *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall. <https://psycnet.apa.org/record/1985-98423-000>
- Benera, V. E. (2003). *Formuvannya piznavalnoyi samostiynosti v maybutnikh vykhovateliv doshkilnykh navchalnykh zakladiv zasobamy intelektualnoyi hry* [Formation of cognitive independence in future educators of preschool educational institutions by means of intellectual game]. [Abstract of PhD thesis]. M. P. Drahomanov National Pedagogical University, Kyiv. <http://www.lib.ua-ru.net/diss/cont/35576.html>
- Camerer, C., & Yoon, C. (2015). Introduction to the journal of marketing research special issue on neuroscience and marketing. *Journal of Marketing Research*, 52, 423 – 426. <https://journals.sagepub.com/doi/10.1509/0022-2437-52.4.423>
- Della Sala, S., & Anderson, M. (2012). *Neuroscience in education: the good, the bad, and the ugly*. Oxford: Oxford University Press.

- <https://oxford.universitypressscholarship.com/view/10.1093/acprof:oso/9780199600496.001.0001/acprof-9780199600496>
- Dyganova, E. A. & Yavgildina, Z. M. (2016). Culture of Self-education of the Teacher-Musician. *Rupkatha Journal on Interdisciplinary Studies in Humanities*, 8(2), 79–90. <http://rupkatha.com/teacher-musician/>
- Genkal, S. E. (2008). *Orhanizatsiya samostiyanoi piznavalnoi diyalnosti uchniv profilnykh klasiv na osnovi individualnykh osvıtnikh proektiv*. [Organizing of independent cognitive activity of students of profile classes on the basis of individual educational projects]. (Abstract of PhD thesis). The Institute for Pedagogy of the Academy of Pedagogical Sciences of Ukraine, Kyiv. https://scholar.google.com.ua/scholar?hl=ru&as_sdt=0,5&cluster=9076191778350663241
- Gerasymova, I., Maksymchuk, B., Bilozero, M., Chernetska, Yu., Matviichuk, T., Solovyov, V., & Maksymchuk, I. (2019). Forming professional mobility in future agricultural specialists: the sociohistorical context. *Revista Romaneasca pentru Educatie Multidimensionala*, 11(4), 345–361. <https://doi.org/10.18662/rrem/195>
- Jarvis, P. (2004). *Adult education and lifelong learning, theory and practice*. London: Routledge. <https://www.routledge.com/Adult-Education-and-Lifelong-Learning-Theory-and-Practice/Jarvis/p/book/9780415494816>
- Kahneman, D., & Tversky, A. (Eds.). (2000). *Choices, values, and frames*. Cambridge: Cambridge University Press. <https://psycnet.apa.org/record/2000-16067-000>
- Kaletnik, G. M., Zabolotnyi, G. M., & Kozlovskiy, S. V. (2011). Innovatsiyeni modeli upravlinnya stratehichnym ekonomichnym potentsialom suchasnykh ekonomichnykh system [Innovative models of strategic management economic potential within contemporary economic systems]. *Aktualni problemy ekonomiky* [Actual Problems of Economics], 4(118), 3–11. https://www.researchgate.net/publication/298002657_Innovative_models_of_strategic_economic_potential_management_within_contemporary_economic_systems
- Kapustyan, I. I. (2012). *Shvedskyy dosvid rozvytku IKT u systemi nepererвної pedahohichnoyi osvity* [Swedish experience in the development of ICT in the system of continuing pedagogical education]. Poltava: Poltava National Pedagogical University. https://scholar.google.com.ua/scholar?hl=ru&as_sdt=0,5&cluster=5869493470362719034
- Klyasen, N. (2014). *Pislyadyplomna pedahohichna osvita: zarubizhnyy dosvid ta suchasna praktyka* [Postgraduate pedagogical education: foreign experience and modern practice]. *Nova pedahohichna dumka* [New pedagogical thought], 2, 187–190. http://nbuv.gov.ua/UJRN/Npd_2014_2_56

- Korohod, T. O. (2013). *Kompetentnisnyy pidkbid do orhanizatsiyi samostiynoi piznavalnoi diyalnosti studentiv nemovnykh spetsialnostey u protsesi navchannya inshomovnoho profesynoho spilkuvannya* [Competence approach to the organizing of independent cognitive activity of students of non-language specialties in the process of learning foreign language professional communication]. *Visnyk Chernihivskoho natsionalno pedahohichnogo universytetu. Pedahohichni nauky* [Bulletin of Chernihiv National Pedagogical University. Pedagogical Sciences], 108(2). http://nbuv.gov.ua/UJRN/VchdpuP_2013_2_108_40.
- Kovalchuk, V. I. (2014). *Teoretychni i metodychni zasady rozvytku pedahohichnoyi maysternosti maystriv vyrobnychoboho navchannya profesyno-tekhnichnykh navchalnykh zakladiv u pishyadyplomnyi osvity* [Theoretical and methodical bases of development of pedagogical skill of masters of industrial training of vocational and technical educational institutions in postgraduate education]. (Abstract of PhD thesis). Classic Private University, Zaporizhzhia. https://scholar.google.com/scholar?hl=uk&as_sdt=0,5&cluster=9253672880475747962
- Kovtonyuk, H. M. (2013). *Formuvannya profesynoi hotovnosti maybutnikh uchyteliv fizyko-matematychnykh dystsyplin do orhanizatsiyi samostiynoi piznavalnoi diyalnosti shkolnyariv* [Formation of professional readiness of future teachers of physical and mathematical disciplines to the organize of independent cognitive activity of schoolboys]. [PhD thesis]. Mykhailo Kotsubynskyi Vinnytsia State Pedagogical University, Vinnytsia. <http://library.vspu.net/handle/123456789/4080?show=full>
- Kravchenko, K. A. (2010). *Osoblyvosti istorychnoho rozvytku vyshchoyi pedahohichnoyi profesynoi osvity Nimechchyny* [Features of historical development of higher pedagogical professional education of Germany]. *Zbirnyk naukovykh prats Umanskoho derzhavnogo pedahohichnogo universytetu imeni Pavla Tychyny* [The Collection of Scientific Works of Pavlo Tychyna Uman State Pedagogical University], 2, 315–323. http://library.udpu.org.ua/library_files/zbirnyk_nayk_praz/2010/2010_2_40.pdf.
- Kuzminsky, A. I. (2003). *Teoretyko-metodolohichni zasady pishyadyplomnoi pedahohichnoyi osvity v Ukraini* [Theoretical and methodological principles of postgraduate pedagogical education in Ukraine]. (Abstract of PhD thesis). The Institute of Pedagogy and Psychology of Professional Education of the Academy of Pedagogical Sciences of Ukraine, Kyiv. <http://www.disslib.org/teoretyko-metodolohichni-zasady-pishyadyplomnoi-pedahohichnoyi-osvity-v-ukrayini.html>
- Leontiev, A. N. (2005). *Deyatelnost. Soznaniye. Lichnost* [Activity. Consciousness. Personality]. Moscow: Smysl. <http://www.psy.msu.ru/people/leontiev/dsl/index.html>

- Li, L., Gow, A.D.I., & Zhou, J. (2018). The role of positive emotions in education: a neuroscience perspective. *Mind, Brain, and Education*, 14(3), 220–234. <https://doi.org/10.1111/mbe.12244>
- Maksymchuk, B., Matviichuk, T., Solovyov, V., Davydenko, H., Soichuk, R., Khurtenko, O., Groshovenko, O., Stepanchenko, N., Andriychuk, Y., Grygorenko, T., Duka, T., Pidlypniak, I., Gurevych, R., Kuzmenko, V., & Maksymchuk, I. (2020). Developing Healthcare Competency in Future Teachers. *Revista Romaneasca Pentru Educatie Multidimensionala*, 12(3), 24–43. <https://doi.org/10.18662/rrem/12.3/307>
- Melnyk, N., Bidyuk, N., Kalenskyi, A., Maksymchuk, B., Bakhmat, N., Matviichenko, O., Matviichuk, T., Solovyov, V., Golub, N., & Maksymchuk, I. (2019). Modely y orhanyzatsiyone osobyne profesionalne obuke vaspytacha u pojedynym zemlyama Evropske Unyje y u Ukrayiny [Models and organizational characteristics of preschool teachers' professional training in some EU countries and Ukraine]. *Zbornik Instituta za pedagogska istrazivanje*, 51(1), 46–93. <https://ipisr.org.rs/images/pdf/zbornik-51/Natalija-Meljnik.pdf>
- Nerubasska, A., & Maksymchuk, B. (2020). *The demarkation of creativity, talent and genius in humans: a systemic aspect. Postmodern Openings*, 11(2), 240–255. <https://doi.org/10.18662/po/11.2/172>
- Nychkalo, N. H. (2009). *Andragohika v systemi pedagogichnykh nauk* [Andragogy in the system of pedagogical sciences]. *Osvita doroslykh: teoriya, dosvid, perspektivy* [Adult education: theory, experience, prospects], 1, 7–20. <https://core.ac.uk/download/pdf/160006964.pdf>
- Oliynyk, L. M. (2015). Zastosuvannya bazovykh servisiv Google u systemi pislyadyplomnoyi pedahohichnoyi osvity [Application of basic Google services in the system of postgraduate pedagogical education]. *Informatsiyini tekhnolohiyi v osvity* [Information technology in education], 22, 93–102. http://ite.kspu.edu/webfm_send/815
- Onishchuk, I., Ikonnikova, M., Antonenko, T., Kharchenko, I., Shestakova, S., Kuzmenko, N., & Maksymchuk, B. (2020). Characteristics of foreign language education in foreign countries and ways of applying foreign experience in pedagogical universities of Ukraine. *Revista Romaneasca Pentru Educatie Multidimensionala*, 12(3), 44–65. <https://doi.org/10.18662/rrem/12.3/308>
- Pereyaslavskaya, S. O. (2011). *Orhanizatsiya samostiyanoi piznavalnoyi diyalnosti maybutnykh uchyteliv informatyky v umovakh zastosuvannya mul'tymediynykh elementiv dystantsiyneho navchannya* [Organization of independent cognitive activity of future teachers of informatics in the conditions of application of multimedia elements of distance learning]. (Abstract PhD thesis). Taras Shevchenko Luhansk National University, Luhansk.

- https://scholar.google.com.ua/scholar?hl=ru&as_sdt=0,5&cluster=3093298391668050476
- Ryabchenko, L. O. (2011). *Upravlinnya samostynoyu piznavalnoyu diyalnistyu maybutnikh ekonomistiv* [Management of independent cognitive activity of future economists]. [PhD thesis]. Classic Private University, Zaporizhzhia. http://catalog.library.tnpu.edu.ua:8080/library/DocDescription?doc_id=439016
- Samuseviča, A., & Striguna, S. (2017). The development of teachers' pedagogical competence in the process of self-education at the university. *International Journal on Lifelong Education and Leadership*, 3(2), 39–46. <https://dergipark.org.tr/tr/download/article-file/551098>
- Savosh, V. (2017). *Rozvytok hotovnosti maybutnikh vchyteliv fizyky do orhanizatsiyi samostynoyi piznavalnoyi diyalnosti starsboklasnykh zasobamy modelyuvannya* [Development of readiness of future physics teachers to organize independent cognitive activity of high school students by means of modeling]. [Abstract PhD thesis]. Pavlo Tychyna Uman State Pedagogical University, Uman. <https://nauka.udpu.edu.ua/wp-content/uploads/2017/09/Savosh-avtoreferat.pdf>
- Sheremet, M., Leniv, Z., Loboda, V., & Maksymchuk, B. (2019). The development level of smart information criterion for specialists' readiness for inclusion implementation in education. *Information Technologies and Learning Tools*, 72, 273–285. <https://journal.iitta.gov.ua/index.php/itlt/article/view/2561>
- Soldatenko, M. M. (2012). *Samoosvitnya diyalnist yak zasib profesijnoho stanovlennya ta samorozvytku* [Self-educational activity as a means of professional development and self-development]. *Naukovyi visnyk Mykolajivskoho derzhavnogo universytetu imeni V. O. Sukhomlynskoho. Seriya: Pedagogichni nauky* [V. O. Sukhomlynsky Scientific Bulletin of Mykolayiv State University. Series: Pedagogical Sciences], 1(36), 39–42. http://nbuv.gov.ua/UJRN/Nvmdup_2012_1.
- Sysoyeva, S. O. (2011) *Interaktyvni tekhnolohiyi navchannya doroslykh* [Interactive technologies of adult learning]. Kyiv: Borys Hrinchenko Kyiv University. https://kubg.edu.ua/images/stories/Departaments/osvitology/book_siso_eva-internet.pdf
- Vashchuk, O. V. (2001). *Aktyvizatsiya piznavalnoyi diyalnosti uchniv 5-7 klasiv u protsesi samostynoyi roboty na urokakh trudovoho navchannya zasobamy novykh informatsiynykh tekhnolohiy* [Activation of cognitive activity of pupils of 5-7 classes in the course of independent work at lessons of labor training by means of new information technologies]. [Abstract of PhD thesis]. M. P. Drahomanov National Pedagogical University, Kyiv. <http://enpuir.npu.edu.ua/handle/123456789/15670>