УДК 378.4
DOI: 10.23951/2782-2575-2022-1-13-22

SEMIOTIC POTENTIAL OF TEACHER EDUCATION*

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Abstract. Despite the considerable number of studies dealing with the semiotic aspects of education, none show the full semiotic potential of pedagogical education. This study presents the hierarchies of sign systems and their application in the training and development of future teachers. The use of A.B. Solomonik's pyramid of sign systems to determine the semiotic potential of pedagogical education is particularly relevant. In this context, two goals of pedagogical training are considered.

The first one is to use the sign systems of the given classification to identify the contents of the subject mastered by future teachers and use them for pedagogical interaction. In this case, semiotic research is developed in three directions: the semiotics of visualization of the content of school subjects; semiotics of visualization of the teaching process based on modern possibilities of technical means of education and information and communication technologies; and semiotics of pedagogical communication (internal and external).

The second goal defines the prospects for using the presented semiotic pyramid for cultivating a general professional culture for student teachers. However, as a science, education does not have formalized first and second-order systems within the given classification. In this study, stereotypes (perceptions, images, behaviors) that determine the dynamics of a future teacher's education and development function as units of sign systems. The development of stereotypes of pedagogical culture in future teachers determines their professional and personal progress, and the emergence and dynamics of innovative solutions.

The characteristics of the four-level sign systems are given 1) Natural Sign Systems. These are elementary representations of interaction between student and teacher, reflecting life experiences made before the beginning of professional education. 2) Image Systems. These are stereotypes about the school education system held by applicants to the pedagogical universities. Stereotypes have both positive and negative characteristics. 3) Linguistic Systems. Verbal texts contain theoretical information about a particular area of professional culture and presuppose that each student acquires it individually (lecture material, traditional learning assignments, homework). A semiotic model of learning is manifested. The teacher gives a theoretical introduction to pedagogical paradigms – meta stereotypes of pedagogical perceptions and behaviors through language systems. 4) Writing systems. This level of sign systems includes written texts (documents) reflecting pedagogical systems and technologies, educational programs, and standards. A certain role in the formation of stereotypes among teachers is played at this level by the lists of competencies and professional functions defined by educational and professional standards.

A different approach to personal and professional development implies a practice-oriented educational system developed through the continuous exercise of job-related tasks. In this sense, teacher training should reflect professional activity with the broader perspectives of synergy.

* *Original Russian language version of the article:* Sirotkina I.E. "Umnoye umeniye": v kakom smysle mozhno govorit' o "telesnom znanii"? ["Sage Skill":in what Sense Can one Speak of"Bodily Knowledge"?]. *Praksema. Problemy vizual'noj semiotiki – ΠΡΑΞΗΜΑ. Journal of Visual Semiotics*, 2020, no. 2 (24), pp. 225–250.

Keywords: *sign systems, training of teachers, semiotics of pedagogy, image of professional future, general professional culture of teachers, stereotype.*

Despite a considerable number of studies dealing with the semiotic side of education, the hierarchization of sign and communication systems and their application in the training of future teachers has not yet been thoroughly analyzed. The main semiotic positions of educational systems are recognizable in the approaches: semiotic, competence-oriented, integrative-differentiated, axiological [1]. Let us outline the positions corresponding to the principles of systemness, openness, and non-linearity of the educational process. The selection and justification of the three stages of education, considered an information process, makes it possible to assign an essential property (value, quantity, and quality of information) to each stage. The results of the mechanisms of these stages can be recognized as sign forms that reveal the semiotic essence of education [2, 21–22]. Learning touches all levels of semiotics and reaches its highest level as learning is mainly aimed at processing the increasing complexity of information by learners. Thus, learning is a process in which students build information structures in their minds [3, p. 9]. Semiotics helps students learn different disciplines by analyzing verbal, nonverbal, or visual languages [4, p. 14].

Semiotics of education is a relatively new branch of educational philosophy, but it has great potential to solve the contradictory relations of the educational system [1, p. 456]. According to A.B. Solomonik, the author of the concept of General Semiotics, the concept application would be useful in designing the learning process. First, the author reveals the concept by describing three practical applications of the theory, two of which are shown with examples from mathematics [5, 45–47]. Then, he distinguishes six types of sign systems based on six basic signs (taxons) [6, 76]. Finally, a taxonomy is created based on these six categories that define a hierarchical sequence of signs (Fig. 1).

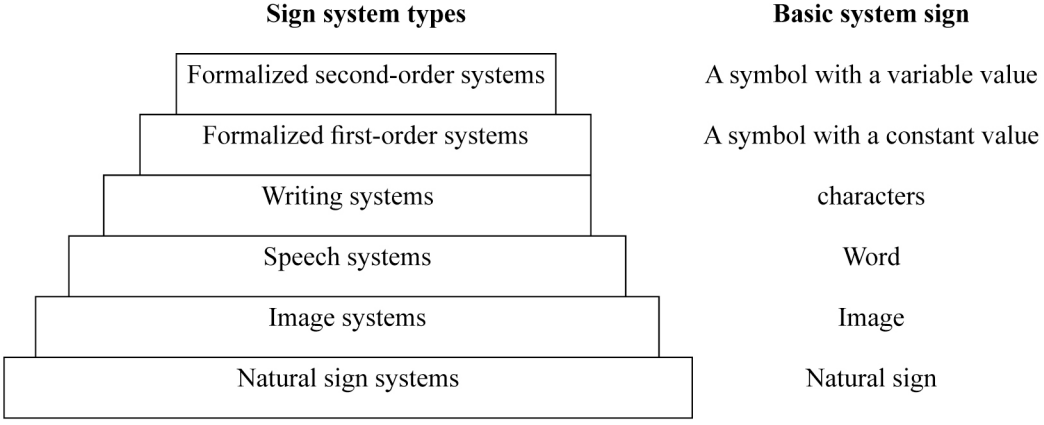

Fig. 1. The pyramid of the sign systems of A. Solomonik

The theory of the semiotic pyramid provides a complete description of the semiotic potential of pedagogical education. Let us consider two educational tasks, the solution of which is in one way or another in the works of pedagogues and philosophers in connection with the types of sign systems highlighted by A. B. Solomonik.

THE FIRST TASK is to use the sign sequence of this classification to identify and apply the content of a subject mastered by future teachers, both for study and for professional and pedagogical interaction. In general, semiotic research related to this problem is determined by *three directions: semiotics of visualization of subject content; semiotics of visualization of the*

learning process (resulting from the possibilities of using modern teaching aids and modern information and communication technologies); and *semiotics of pedagogical communication*, i.e., the study of sign information, which is the basis of pedagogical communication.

In *the first direction*, the research refers to the semiotics of visualization of subject content. Here it is appropriate to consider the application of the semiotic pyramid to the content of a particular group of academic disciplines, particularly the natural sciences and mathematics. For example, the natural sciences, which we consider to be highly theoretical, have a long tradition of using numerous visual resources and representations, such as graphs, drawings, diagrams, three-dimensional models, and more [7]. This is also true for mathematics, which is becoming more accessible with new illustrations of concepts and theorems, especially in the development of computer multimedia technology, which has dramatically expanded the possibilities of modern animation. Thus, in particular, mathematics dealing with precise graphical constructions has greatly benefited from the transition from picture-by-picture drawing to the description of the behavior of vector objects [8, 22].

Detailed semiotics of mathematics learning makes it possible to visualize mathematics learning: the construction of a visual learning environment [9, 297], the search for rational methods of question formation (within the framework of erotetic semiotics), the construction of correct answers through the language of mathematics, its syntax, semantics, and pragmatics [10, 63–64], and much more. The semiotics of physics learning is also prominent in their methods and visualized images: Mental Experiment, Physical Model, Ideal Object, Physical Analogy [11, 242–246]. In fact, it can be said that the determinations of communication and sign systems with a high level of abstraction and formalization of the first and second levels have reached the exact, informational, and natural sciences, which defines them as semiotically oriented in relation to the content of the discipline. Native language and foreign language are represented by such levels of abstraction. For this reason, the theory studied in foreign language teaching overlaps with both native language teaching and the metatheory of natural sciences. This allows for a semiotic approach to the problem of interdisciplinary connections in teaching a linguistic or non-linguistic subject, based on the logical and psychological commonality of the difficulties encountered in their study [12, 185–214].

The *second direction* is *the semiotics of visualization of the learning process*. At the modern level, the studies on the semiotics of visualization of learning processes are based on the possibilities of modern teaching aids and modern information and communication technologies. A good example of the new visualization possibilities is interactive whiteboards, interactive digital boards, and tables, widely used for educational purposes. In addition, students perceive visual material better when they study using interactive maps, drawings, and diagrams [13]. Clearly, the digitization of education, which includes online learning, digital textbooks, and digital educational environments, will significantly change the course of pedagogical education. Thus, new elements of digital didactics of education are emerging – ways of teaching that expand the visualization and sign structure of the teacher education process.

The third direction of pedagogical semiotics (related to the first task) refers to the study of sign information, which is the basis of pedagogical communication: both *external* (dialog) and *internal* (textual and visual thinking) communication.

At its core, *external communication* reflects the knowledge-semiotic component of pedagogical culture. That is, pedagogical communication occurs through the mutual translation of knowledge between the subjects of the educational process, the Lecturers, and the Education Student.

In the theory of pedagogical communication, two types of communication are distinguished: verbal and nonverbal. The first refers to speech (verbal communication, dialogs, monologs); written communication (handwriting, texting, typing); internal communication (thought formation, internal dialog). Text semiotics and its applications in pedagogy are among the basic skills of a successful individual. In particular, it involves finding pedagogical ways to introduce and justify reading in the context of a variety of subjects. [14, 368–370, 374, 377]. In fact, the semiotic approach of teaching school subjects in verbal communication between teacher and student (i.e., based on the text) is quite well developed in home education. Since the teacher's pedagogical communication with the students is essentially limited to the framework of subject teaching, we can consider it as an element for solving the first problem related to the subject matter.

The second type of external pedagogical communication – is non-verbal communication. It is a general means of communication that has an educational and motivational effect on students. Non-verbal communication includes other types of communication than verbal: body language (gestures, facial expressions, and posture); visual (visual evaluation in the first seconds of getting to know each other, determination of gender, age, evaluation of appearance, and facial expression); auditory perception (evaluation of voice – rhythm, timbre, volume, brightness, pauses, coughs, filler words), tactile communication (touch); smells (attractive, unattractive); mobility (low, high, irritating); boundaries of personal space (pleasant or unpleasant transition). In pedagogical educational institutions, nonverbal communication is considered a method of communication that provides the most important information about personality and other success in pedagogical activity [15, 28–33]. At the same time, psychological and educational studies dealing with the formation and development of visual thinking focus on the processes and patterns of nonverbal thinking, the problems of visual perception, and information transmission [9, 298].

When studying visual thinking in pedagogy, it is necessary to refer to the key works of the American psychologist Rudolf Arnheim, who coined the term Visual Thinking [16, 17]. His work laid the foundation for modern ideas reflecting the role of visual phenomena in the thinking operations of school children, illustrated by several examples of cognitive activities in the natural and social sciences. Specifically, "When students view a map not as a set of shapes but as a configuration of visual forces, the knowledge to be gained is appropriately transformed into the play of these forces in other areas of science – physics, biology, economics, and politics" [18, 217]. The nature of visual thinking is also well illustrated by Arnheim's example about the time problem of Peter and Paul [19, 81].

As for the three directions to solve the first problem with the semiotic approach to teacher education, it is important to expand the meaning of the semiotic context of teacher education beyond the subject and the related communicative aspects of the teaching profession to represent the multilevel sign systems of pedagogical education as a whole.

THE SECOND TASK The development and application of sign systems in pedagogical training are related to the application of the semiotic pyramid to systematize and cultivate the general professional culture of pedagogical students in the course of their training. Here we encounter some limitations. Pedagogy as a science does not have higher levels of semiotic formalization, i.e., formalized first and second order systems within the framework of the cited classification. At the same time, the sequential construction of only the first four sign systems of professional teacher activity requires detailed analysis for application in teacher education and investigation of the problems of semiotic influence at each level of sign systems.

To illustrate the sign systems at each level, we use the concept of stereotypes in this article because their role in forming and changing personal perceptions, images, and behaviors in the profession determines the dynamics of the future teacher's development and education.

1. **Natural sign systems.** At this level of representations, students show an elementary understanding of the interactions between a student (children, adolescents) and a supervisor (adults), between a student and a teacher. This level of conception about the pedagogical activity usually reflects the life experience that the applicant has had before starting the professional training.

2. **Image systems.** The classroom-lesson system and its characteristics. The conception of the classroom system as the school's image is typical for applicants to pedagogical universities. This system is quite solid in the initial stage of training and is reinforced in the course of learning in pedagogical training areas and specialties.

This level includes a number of image systems that represent stereotypical attitudes towards the professional activity of a teacher. Often, such ideas come from the students' worldview, supported by irrelevant data from teachers and classmates in the process of acquiring initial academic knowledge about the teaching profession.

At this point, theoretical expertise predominates perceptions about the profession based on practical experience are minimal. When there is a discrepancy between students' previous conceptions and the information they have received in the early stages of their academic and professional careers, there is an increase in their emotional background. Since much of the information received from teachers about the future profession is averaged and standardized, an opinion about the characteristics of people and phenomena is formed, which psychologists call a stereotype, namely "biased, not based on a direct assessment of the phenomenon in question, but derived from standardized judgments and expectations" [20, 188]. Students' perceptions are dominated by fixed attitudes that contain nothing more than stereotypical behavioral dispositions to respond to the situation in a certain way [21, 44–45].

According to the modern definition, a Stereotype is a persistent image or idea that is emotionally colored by prejudice or bias, i.e., a stable evaluation. Stereotypes have both positive and negative characteristics. A separate chapter in the book by I.S. Sergeev [22, 133–125] is devoted to the analysis of positive and negative aspects of stereotypes in educational work, including those based on the context of educational paradigms.

3. Language systems. Verbal texts contain theoretical information about a specific area of professional culture (lecture material, traditional learning tasks, homework). The main unit of influence in relation to students is a speech act. The semiotic teaching model of A.A. Verbitsky and M.D. Ilyasova deals with this level [23, 72, 237–238]. In the course of teaching, students are engaged in traditional academic learning activities, and existing practice conveys ideas about the standard tasks of a teacher. In this way, stereotypes for practical pedagogical activities are formed. The organization of students' activities is focused on mastering the educational information conveyed by the instructor. It is typical for a classical lecture that the lecturer uses a semiotic teaching model. Based on this situation, it can be argued that the lecturer theoretically introduces the student to different educational paradigms (humanitarian, personality-building, competency-based). Thus, at this level of the semiotic model of teacher education, a polyparadigmatic approach is implemented, which is not accompanied by the disclosure of practice-oriented actions of one or another educational paradigm as a complete metastereotype. However, this leads to the formation of stereotypes in a future educator, which is typical for the understanding of a number of educational paradigms. It should be noted that the language systems of certain areas of professional culture produce specific stereotypes while enabling them to reach the next levels of the semiotic pyramid. Teachers have individual constructions of pedagogical culture and form their own stereotypes in which behavioral stereotypes are actualized. When training a young teacher, it is important to develop the ability to change behavioral stereotypes in time.

4. Writing systems. This level of sign systems includes written texts that reflect pedagogical technologies, pedagogical systems, and educational programs and standards in general.

At this level, the lists of competencies of the educational standard and the list of general work functions defined by professional standards play an important role in constructing stereotypes in teachers.

Here, the consideration of the stereotype complex as a high-level sign system should be discussed from two aspects. The first aspect refers to the mastery of pedagogical competencies as a system of stereotypes that define pedagogical activity. The second aspect refers to the study of how the stereotype complex (both in terms of representation and behavior) can be replaced in teachers during their training and development. This may be related to changing the pedagogical paradigm of a given educational system to replacing stereotypes with more advanced ones.

Thus, the first aspect refers to the pedagogical training of students, the formation of their readiness for professional activity, which determines their readiness to solve professional problems. At this level of the sign systems used in the semiotic pyramid, the bearer of a set of stereotypes manifests the leading forms of social consciousness. In describing social stereotypes as leading forms of social consciousness, Yu. S. Chaplygina suggests ten forms social stereotypes: Gender, age, ethnic, cultural-geographical, religious, material, group, individual, occupation [24, 680]. It can be assumed that all listed forms of social stereotypes are relevant for training students in the system of higher teacher education, but we highlight the last three, which we update for this semiotic level of personal-professional development of a future teacher. Note that the first seven forms of social stereotypes relate to the value-forming component of teacher education. For the last three forms of social stereotypes, the following three objects of stereotyping are identified: 1) corporate value characteristics; 2) egocentric value characteristics; 3) metrics of competence and proficiency in professional education.

Achieving a meaningful level of stereotyping and positive effects through its application in a professional activity is possible through the extended interaction of students with professional communities. Representatives of such communities are carriers of professional values and corporate culture, and they act as valuable subjects of interpersonal communication, including informal communication. Such communication makes it possible to understand and accept the profession's values in practice and adjust the individual values of a prospective teacher.

Representatives of professional communities make it possible to actualize real professional tasks. It is important to actively involve prospective teachers in solving current professional problems with the participation of experienced teachers. In our experience, it is possible to accomplish this through various individual pedagogical practices, including voluntary practices [25, 105–106]. We consider such practices as complementary to the field practices carried out within the educational program of universities. In this sense, there is an expansion of the patterns of the practical pedagogical activity, the acquisition of pedagogical stereotypes acquired through interaction with experienced teachers. Moreover, experienced teachers help students gain experience in solving a reverse problem: overcoming one or another pedagogical stereotype. The next aspect of stereotypes in the pedagogical profession is emerging as a semiotic system of recording a teacher's pedagogical culture.

The second aspect is relevant to the training and development of prospective teachers and determines their willingness to change the stereotypes of pedagogical culture and behavior. It is essential for achieving sustainable learning outcomes in students, it is a prerequisite for replacing outdated stereotypes with new ones in the transition from one educational paradigm to another, it is a factor that marks the educational system as innovative. Y.A. Sorokin defines a stereotype as a certain process and result of communication (behavior) in accordance with a certain linguistic

(semiotic) model, which is implemented as a system of Correct communication at the social, socio-psychological level (standard) or at the linguistic, socio-psychological level (norm) [26, 11]. The existence of standard and norm is defined in two ways – as a stamp and as a cliché. A stamp is understood as a redundantly explicated (explained) complex sign, and a cliché is an insufficiently explicated complex sign. The analysis of the scientific literature allowed us to identify the main points that form the theory of stereotypes in pedagogy [27]. In particular, the role of currently existing stereotypes in the formation of distant goals is determined. At the same time, the prevailing stereotypes remain those that were laid in the process of training and education. In this sense, the creation of new stereotypes of pedagogical culture is a promising way to shape a person's professional path. This is by no means a trivial task. Even Pitirim Sorokin, without applying the concept of behavioral stereotype, described the problem of changing behavioral patterns in sociocultural groups, noting that "a momentary, simultaneous, and identical change in the behavioral patterns of all group members ... is almost impossible" [28, 34].

It was logical to conclude the consideration of this level with a set of stereotypes related to pedagogical skills and functions, but this is clearly insufficient for the training of future teachers. The emergence of somewhat different sign structures is determined by the following: the self-determination of the student in professional training, the structure of individual psychological qualities, the acquisition of an individual pedagogical experience that forms qualities significant for professional activity. We believe that this leads to the formation of a special semiotic component in the personality of the subject of the educational process at this level. In determining the personality structure of students, researchers endow them with integrative properties and regulators that ensure the interaction of the internal substructure (norms, values, personal ideas about the profession) with the external substructure (forms of behavior – communicative, active, reflexive) [29, 190]. Under the same aspect of personality formation of future teachers, but in the context of their readiness for social pedagogical activity, the static substructure (cognitive-operational, value-motivational, emotional-volitional components) and the dynamic substructure (readiness for continuous education and professional improvement, social and professional mobility, orientation towards personal self-development) are identified [30, 111]. Static and dynamic personality substructures and their interaction also lead to integrative education, which is essentially semiotic in nature.

E.M. Kharlanova's integrative concept of social educator training, both in terms of social activity and professional readiness, establishes an important semiotic construct of a student's personality – "a picture of the desired professional future and plans for its realization, which represent the subject's inner program" [31, 113]. The manifestation of the Semiotic Construct in the personality of future teachers in the form of the "image of the desired professional future" allows us to assert the completeness of the teacher education process, subject to the manifestation of the stereotyped system of competencies and coordinated professional functions, based on the specific basic educational programs of teacher education at the university. Based on these considerations, we consider the fourth level of the semiotic pyramid as complete, considering that the conditional schema of the "image of the desired professional future" acts as the hieroglyph of this level, i.e., it is the basic sign of the semiotic systems of this level of teacher education.

Thus, the semiotic context of higher pedagogical education allows presenting a system of formation of pedagogical stereotypes and providing a mechanism for their replacement. At the same time, this system's organizational and pedagogical conditions are as follows: Availability of professional communities, the possibility to choose the individual practice-oriented path of the pedagogical activity, and activities within the presented levels of sign systems of pedagogical education. Please note that the first four levels of the presented semiotic systems of teacher

education (in the logic of the six-part classification of A.B. Solomonik) are limited and presented only from the point of view of the role of stereotypes in the education of future teachers. The last two levels of the semiotic pyramid in relation to teacher education, which could be represented as first and second-order formalized systems, are beyond the scope of this study.

One can also conclude that during teachers' personal-professional self-determination and personal development, certain semiotic models of learning are necessary, and their subsystems are complexes of stereotypes that seem to determine the invariance and linearity of unfolding teacher education. However, already in problem teaching (lecture or seminar discussion), the professional and social contexts of future professional activity are outlined and the actions of professionals discussing theoretical, inherently contradictory questions and problems are modeled. Moving from model actions to real actions, one can argue about the increasing role of nonlinear processes in teacher education. This is usually done in the context of a comprehensive pedagogical practice characterized by the performance of non-standard tasks. In other words, considering pedagogical training as a complex system that enables the application of a synergistic apparatus and appropriate semiotic models to the formation of the personality of future teachers is an important research direction. Thus, we consider pedagogical education as an open system aimed at the personal and professional development of future teachers through a continuous solution of professionally oriented tasks. In this sense, teacher education should also reflect the intended personality of students' professional activity from the point of view of synergy.

A synergy of the educational process is a unifying interaction of personal and self-developing factors [32]. As an inherent element of self-organization and development of future teachers, the synergy effect manifests itself in the solution of increasingly complicated pedagogical, quasi-professional, and professional tasks. The most important aspect of solving complex tasks is the creation of a transition hierarchy from basic activity to higher level teaching activity structures. Such an approach is realized in higher education through contextual (sign-contextual) learning [33] by applying semiotic, simulative, and social learning models [23, 72, 231] and constructing a hierarchy of visual models and processes in the disciplines under study [34, 147–148]. Considering the above and our experience of giving students a variety of pedagogical examples, we can assume that the acquisition of professional skills requires the personal experience of solving tasks in the semiotic context of pedagogical education. Updating of professional tasks for students' professional examples is carried out by subjects of different educational systems (general, additional, higher education). The highest level is considered to be the mastering of the stereotypes of the competencies of the educational standard, which form the image of the desired professional future. Therefore, the perspectives of teachers' abilities, including their manifestation in innovative pedagogical activity, should be determined by their ability to change pedagogical stereotypes. The consequence of giving a semiotic context to the process of pedagogical education is reflected in the fact that "... all stages of the information process... whose nature is determined by channels of communication that distribute the roles of educational subjects; the semiotic nature of education determines the sequence of these stages from dogmatics to creativity" [2, 22].

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