Recursive Model of a Methodical Competency Formation of a High School Teacher in the Context of Competency-Based Education

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Abstract

The present study examines the professional development problems of a high school teacher. High school teacher is both a scientist and a teacher. Teaching and research activities are integrated by his methodical activity. Methodical competency of a teacher is defined as a basis in the context of Competence-based Education. Methodical competency building model is founded upon recursion. Recursion, as a technique based on consistent reduction of a complex problem solution to solutions to a set of "simpler problems" of the same class and obtaining on this basis the solution to the original problem, allows the teacher to build an individual route to form and develop methodical competency. Teacher performs different types of methodical activities (educational and methodical, scientific and methodical, organizational and methodical, and examination and methodical activities) in "non-linear" way, as well as assimilates the corresponding methodical roles (engineer, researcher, expert, manager, and teachers' coach). Actually, the beginning of assimilation of one role is accomplishment and/or continuation of the other role. Thus, the methodical competency structures, recursively referencing to each other, are developed out of themselves.

Keywords: high school teacher, methodical competency, professional development, recursive model, competency-based education

1. Introduction

1.1 Competency-Based Education (CBE) in Higher Education Institution in Russia: Context and Implementation

Higher professional education (HPE) modernization prospects in the Russian Federation are related to the integration into the international educational process. Full implementation of the Bologna Declaration in higher education institutions (HEI) of the country became possible only after the approval of the Federal Government Standard of the 3rd generation (FGS-3) (www.fgosvo.ru/) and the new law "On Education» (www.mon.gov.ru/). The peculiarity of FGS is the availability of the requirements to the results of the basic educational programs assimilation in terms of competencies that is in conformity with the CBE, adopted by European educational community.

In the international project "Tuning Educational Structures in Europe" (www.unideusto.org/), the concept of "Competency" has an integrated nature. It includes: 1) knowledge and understanding (theoretical knowledge of an academic field and the ability to know and understand); 2) knowledge of how to act (practical and operational application of knowledge to specific situations); 3) knowledge of how to be (values, as an integral part of the way of perceiving and living with others in a social context). Russian researchers (Zimnyaya, 2004; Tatur, 2004) consider semantic content of the "cognizance" concept with certain connotations. Summarizing the existing interpretations, it can be concluded that CBE is a kind of educational content, which involves not just a certain amount of learned information, but holistic experience of student's independent solution to recurring professional problems, and generally, the problems of his entire life in a new and uncertain contexts.

Russian higher education is associated with some difficulties in the implementation of CBE. The reason for this circumstance is found in a university teacher. On the one hand, there is a tendency on deterioration in the demographic profile of the teaching staff (Krukhmalev & Nazarova, 2005). On the other hand, we emphasize that the CBE is in opposition to the traditional explanatory and illustrative teaching with dominated straight and informational methods that are prevailing in Russian higher school for a long time. The CBE involves more

practical approach in knowledge transfer. This necessarily entails the introduction of innovative educational methods and technologies into the university educational process. These educational technologies, methods and pedagogical approaches include active learning, interactive whole-class teaching, e-Learning, student-centered methods, case-study method, methods of organization of independent work of students, and others. Though research shows (Solovova, 2010) that the level of theoretical knowledge and methodical skills for the implementation of CBE is not quite sufficient for both new entrants into the teaching profession and those having considerable experience. The obstacles are created also due to stereotype of the teaching paradigm, the so-called authoritarian pedagogy, as well as the lack of psychological and pedagogical readiness of teachers for continuing professional growth.

It is important to remember that education is one of the leading social activities, which performs the socialization process of a person and forms the historical and social process. Educational goals and values are a dynamic phenomenon; they reflect the social mandate of society. The logic of their development is that they are changing both depending on local transformations in the socio-cultural environment and, in general, on changing epochs. Philosophical thought captures changes in the value orientations and behavioral patterns of young people (Bauman, 2000; Lipovetsky, 1983; Hagurov, 2006). A number of researchers come to the conclusion that Homo Consumer becomes a common type of human among people. It is difficult to teach creative thinking and the ability to competently operate in abnormal situations a young man, who used to consume not only products, but the ideas and solutions. It is therefore necessary that very teacher should be changed and evolved (Joosten, 2013; Fink, 2003; Hargreaves, 1994). Broadly speaking, teaching profession belongs to the category of "semiotic" professions. The idea is that the teacher, beyond his will and desire, stands as a symbol and as an element of culture. His major professional function is to be bearer of certain activities and deploy them as role models when transferring to other people (e.g. students). And thus, the example of the continuing professional development of university teachers and professors is one of the conditions to form creatively thinking competent student.

1.2 The Activity Specifics and Competency Structure of Teachers in the Russian Higher Education Institutions

Professionalism of higher education teachers and the structure of their competency are manifested in their activities. Teacher's activity has a complex structure and consists of several types, having common components interrelated with each other. The main activities are: teaching, research, and professional activities (basic specialty), as well as administration and maintenance activity, managerial, commercial and public activities (Matushansky, 2003). Among them, the predominant role is given to research and teaching. Dominance of any of these activities often has a negative impact on teacher's professional growth. Usually a teacher with predominance in pedagogical activity not quite intensively conducts research work. As a result, he has difficulty in solving the problems on the transformation of scientific knowledge into a school subject, selection and organization of educational information, and searching for research methods to solve pedagogical problems. On the other hand, the predominance of research orientation reduces the efficiency of his activity. Communicative competency of such a teacher is underdeveloped. Sometimes he has difficulty in communicating with students, in the organization of students' or colleagues' teamwork. We believe that the methodical activity integrates teaching and research activities, implicitly existing in both of them. The notion of "method" and "technique" are generic with respect to the educational category of "Methodical activity". Combined lexical meaning of these words can be explained as the creation of a certain way of professional activities and the description of their nature, as well as and design of the properties of algorithm-based activity, which leads to the target. In this context, the essence of methodical activity consists in the identification, selection and development of various means to process and present educational material depending on the subjects in such forms, which would be convenient for students to assimilate theoretical knowledge and to form practical skills, i.e. to form their competency in general.

Note that among the teachers of Russian higher education institutions, there are a significant percentage of those, who do not have pedagogical education. Difficulties in implementing methodical activities in this category of teachers are very high. Addressing the problem of psychological and pedagogical competency of teachers among the people with higher non-pedagogical education was outlined as early as in 2001. This year, the Ministry of Education of the Russian Federation approved requirements for the preparation of high school teachers (www.dpo.mirea.ru/). On the basis of these requirements, special university departments, faculties, centers for teachers' retraining and advanced training were established in the country's leading higher education institutions. Researchers and developers of educational programs have formulated teacher's competencies structure. The cognizances are identified in the following areas: 1) taught subject; 2) cognitive activity, contemporary means of obtaining and processing information; 3) philosophical and legal frameworks, governing the intended purpose and the social role of education, functioning and development of Russia's educational system; 4) training and

education theory and methodology; 5) program and methical support of educational process; 6) pedagogical measurements, diagnosis, assessment and analysis of the training and education results; 7) educational process quality control; 8) pedagogical communication and solutions to communicative tasks; 9) general and professional culture; 10) self-development; and 11) organization and conduct of scientific research (Medvedev & Tatur, 2007). We lay emphasis that this list is not entirely complete. One can see that the scope of methical activity as a separate area and, accordingly, methical competency as a particular cognizance, are not included. Note that we make a distinction between the concepts of "cognizances" and "competencies". We treat the first concept as pre-defined social demands to the educational training of a student, whereas the second one is understood as possession of relevant competencies, which include personal attitude towards them and towards the scope of activity. In our opinion, methical competency acts as a steering unit in the effective implementation of the CBE. That's why building of the methical competency formation model of the university faculty members is one of the priority tasks of the higher school pedagogy.

2. Theoretical Framework and Methods

2.1 Modeling as a Method

The sign simulation method is a methical basis for building a recursive methical competence formation model in higher education teachers from those with higher non-pedagogic background. Modeling or simulation is a special method of the theoretical level. At sign simulation, diagrams, drawings and formulas serve models. Simulation is the process of constructing something new that previously did not exist in practice. The researcher, after studying the real processes identifying features and their trends, looks for their new combinations, based on leading idea, regrouping them mentally. Thus, he simulates a desired status of a system being studied. In this study we present a model, which represents a hypothesis on formation of methical competency that reveals the relations between the components of the object being studied.

2.2 Recursion as a Method of General Determination of the Object or Action through This Object or Action, Using the Previously Defined Prejudications

Recursion is a promising technological scheme and evolutionary processes model in a complex structural system, such as a professional and pedagogical competency with its central link, i.e. the methical competency. The concept of "recursion" (from the Latin word recurso, which means running back, hurrying back, coming back) as a method, can be used in various subject areas. Originally, this concept was formulated in mathematical logic and mathematics, from where it transferred to computer science and cybernetics. In the contemporary research recursion is called "method-based technique» (Morin, 1977), the comprehension of understanding in the complexity world. Recursion is the starting point of the autopoiesis theory (Maturana & Varela, 1980), as well as Luhmann's theory of autopoietic social systems.

Recursion is the work based on sequences, linking, repeats and returns. This is a technique, based on consistent reduction of solution to a complex problem to solutions of a set of "simpler problems" of the same class and obtaining on this basis the solution to the original problem.

Analysis of folklore shows that recursivity is laid in the deep layers of the human consciousness, and recursive structures correspond to the ancient archaic way of thinking. In the real world, recursion can be manifested in the form of various configurations, links, informal definitions, structures, reasoning methods, learning methods and other activities. Thus, for example, it may be an image that is repeated in two mirrors, set opposite to each other. Recursion is a musical form, called the canon, where the main melody is accompanied by the same melody, but with a time delay. We emphasize that the recursion, as a learning principle through knowledge, pertains to developing education. Exactly this context of the recursion principle was used by D.E. Knuth, American system programming expert, when presenting educational material.

To build successfully a methical competency formation model, one needs to follow the steps of "recursive triad", namely: 1) to perform the parameterization of the problem (i.e., to identify the initial values that determine the formulation and solution of the problem); 2) to distinguish the base (i.e., to find such sub-tasks that can be solved directly) and to identify possible rules for its modification; 3) to make decomposition (i.e. to decompose the problem into a series of sub-tasks of two types: those that we know how to solve, and those that are in some way similar to the original problem).

3. Results

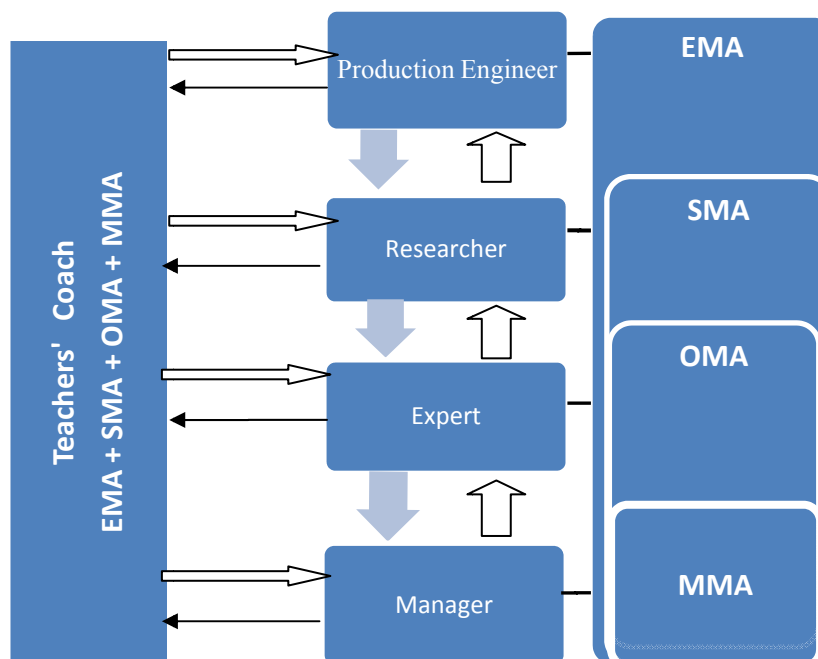The results of theoretical simulation are shown in the diagram (Figure 1).

Figure 1. A recursive methodical competence formation model

EMA–is educational and methodical activity; SMA–is scientific and methodical activity;

OMA–is organizational and methodical activity; MMA–is managerial and methodical activity.

Let's explain above diagram.

The first step, according to the "recursive triad", involves identifying the parameters of methodical competency. First, we offer interpretation of the "methodical competency" concept. Methodical competency is a system-based education, needed for a successful professional pedagogical activity, and consisting of knowledge, skills and abilities of the teacher in terms of methodology, as well as the optimal combination of methods of conscious use of pedagogical tools. Besides, methodical competency is a multi-level integral quality of a person. It combines motivational, objective, axiological, cognitive, and behavioral aspects of the teacher. As a personal quality, it is a condition for effective professional activity, targeted to achieve a new quality of education, to better address the professional tasks. We emphasize that the methodical competency is a dynamic phenomenon. Development of its content is determined by the fact that the socioeconomic order of society is subject to change. And in this regard, new pedagogical approaches are emerged and new pedagogical tools are developed that high school teacher must master. There is no doubt that methodically competent teacher is able to productively answer the following questions, arising in the course of professional activities: 1) "why to teach?" (specification of own general educational goals, set by the national system of education); 2) "what to teach?" (selection, processing and transfer of the teaching material content); 3) "whom to teach?" (the study of students' capabilities and new levels of their mental development); 4) "how to teach?" (selecting and applying appropriate methods, forms and means, as well as their combinations); 5) "who will teach?" (analysis of own educational capabilities and willingness to self-analysis, self-correction and self-development).

Making the second step, it should be noted that the professional activity of a teacher can be dominated by some sort of methodical activities (or their combination) depending on teacher's experience and position. Currently, the duties of the faculty members in Russian universities include several types of methodical activities (Solovova, 2006), namely: educational and methodical, scientific and methodical, organizational and methodical, and examination and methodical activities. Below we reveal the object-matter of each methodical activity type.

✓ Educational and methodical activity is caused by the improvement of teaching methodologies, development of the necessary courseware and teaching aids (curriculum and teaching materials). This kind of activity includes the preparation for training sessions.

✓ Scientific and methodical activities are aimed at the following: the study and compilation of best practices

of the educational process, the development and implementation of innovative methods and learning technologies, as well as methods for monitoring and control of the quality of students' training at all learning stages. Scientific and methodical activity involves the publication of scientific results on the problems of higher education in the scientific periodicals, as well as in proceedings of scientific and methodical conferences.

✓ Organizational and methodical (including examination and methodical) activity requires from teacher the availability of a significant teaching experience and self-organization, as well as developed reflection. It involves participation in the social methodical bodies of educational institution (educational and methodical council of the university, methodical commissions, research and pedagogical and/or research and methodical professional schools and communities), as well as in the management of the University (Vice-Rector, Dean, Deputy Dean, and Head of Department).

According to the third step of recursive triad, we have to identify what kinds of methodical activities are successfully performed by teacher, and which require his further training. To do this, it is necessary to formulate the professional profile of methodically qualified teacher. It can be formed from five roles, referencing recursively to each other. These include the following roles: 1) methodic technologist, 2) methodic researcher, 3) methodic expert, 4) methodic manager, and 5) methodic teachers' coach or "playing coach". Each of these roles is correlated with specific types of methodical activity (Figure 1).

✓ Methodic technologist comprehends its own pedagogical activity (or activities of his colleagues) and technologically forms it as a teaching experience. At the same time, he creates a "bank" of methodic advances (teaching materials, course work programs, etc.), adapted for the transfer to other teachers.

✓ Methodic researcher provides problem analysis of his work, the teaching staff of the department, is looking for new ideas to develop his department or the educational institution in the whole, and simulates new forms of effective operation.

✓ Methodic expert is focused on the monitoring of educational activities quality and the development of specific criteria to evaluate teachers work, as well as is responsible for professional certification procedures.

✓ Methodic manager guides the basic educational process. For example, he monitors compliance of personal teaching tactics to the overall strategy of the educational institution.

✓ The role of methodic teachers' coach is functionally similar to the role of "playing coach". This role requires the ability to demonstrate norms and innovations of pedagogical activity in the actual (or model) learning process, as well as a desire to educate the teachers.

Practical implementation of the recursive methodical competency formation model is provided by the following organizational and methodic conditions.

First. The university should establish reflexive learning environment, focused on the development of methodical initiative and creativity of the teacher. Such an environment should be flexible enough, because it is an environment for the implementation of an individual rout of teacher's professional growth. It is similar to the system of manifold reflecting mirrors: both a teacher to himself and dialogically interacting teachers to each other. Factors, contributing to self-examination, self-correction and fulfillment of a teacher's methodical potential in a reflective learning environment, include: 1) an "open environment" with a friendly attitude and a belief in the abilities of the trained teacher, 2) continuous updating of knowledge and active training, 3) expansion of the technical skills, 4) the presence of a creative environment, frequent communication with bright competent individuals, and 5) creative competitiveness of ideas.

The composition of the structure blocks of reflexive learning environment is variational. Minimally it includes the follows: 1) optical block (a system of inter-attendance of sessions, work observation of creative pedagogical workshops), 2) gnosis and interaction block (includes master classes, discussions, roundtables and other forms of work with the leading teachers of the university, region, Russia and foreign countries), 3) praxis block (the introduction of resolved methodical problems into the educational process in order to improve the quality of mastering teaching materials by the students), 4) reflection metablok (implies a critical rethinking of own methodical activity, and resulting in creation of written scientific research and methodical developments or recommendations). Programs of these activities should be designed for a certain period of time and should take into account the specific educational needs of individual teachers of educational institution, who joined the process of methodical competency formation.

Second. Responsibility for the teacher's professional growth lies not so much on the university structures, but on

the teacher himself. He is the active subject of development and can choose the individual educational rout. In this connection, exactly teacher determines the content of his professional growth, his methods, means and forms. Here are some examples.

Teacher, who took part in a recursive model in graduate period initially as "methodical technologist", after the successful assimilation of this role can continue with the role of "playing-coach", or move to the stage of "methodic researcher", or remain at the stage of "methodic technologist" for further improvement in this area. During the assistant work period, teacher may be simultaneously involved in the assimilating of the two roles, namely "methodical researcher" and "methodical technologist", and then move either to the stage of "playing coach" or "expert", or deepen his knowledge and skills as "methodical technologist". Methodical roles of "researcher", "expert" or "manager" are preferred for high school teachers in the post doctoral period. Yet, at this stage, it is quite possible the implementation and improvement of the "technologist" role. We emphasize that the "teachers' coach" can become a teacher, who has successfully mastered any of the methodical roles and who is motivated to carry out such an important mission.

Third. Each of the stages (when mastering any methodical role) is built also on the recursion principle, using the principles of "experiment-based learning» (Kolb, 1984). Professional development begins with the existing experience and knowledge of the participants.

Methodical knowledge is as a result of inclusion in the differentiated educational program which represents a substantial component of recursive model. Each methodical role contains the base, advanced, creative levels. The thematic plan of the program, the schedule of lessons is developed by the teachers who have already mastered different methodical roles. So, for example, the teacher mastering a role of "methodologist-technologist" studies the invariant module of a basic level: «Didactic process at the higher school», and also any of variety modules («Motivation of informative activity of students», «Development of professional consciousness»). The basic level for "methodologist-researcher" includes the invariant module «Scientific work of the teacher of the higher school», and as a variety, for example, the module «Innovations in educational technologies». The substantial component for "expert", «the playing trainer» is aimed at studying of a technique of working out of author's technology of training.

Next, the teacher should analyze own experiences and highlight its sustainable models. Then, plunging into one of the structure blocks of reflective learning environment and moving consistently or "non-linearly" to the other blocks, the teacher apperceives knowledge from new sources (master-classes, scientific conferences, etc.). Teacher fulfills the acquired knowledge and skills, as well as an action plan, through the intensive practice. He develops and implements methodical projects. This allows the teacher to implement already existing or newly acquired knowledge and skills through personal experience gained in practice-oriented activities. Thus, the beginning of one role is the end or the continuation of the other. Methodical competency structures, recursively referencing to each other, are developed from themselves.

4. Discussion

The problem of teachers' professional growth is sufficiently developed in contemporary science (Akerlind, 2003; Birman, Desimone, Porter, & Garet, 2000; Clarke & Hollingsworth, 2002; Kiffer & Tchibozo, 2013; Hargreaves, 2000; Malm, 2009; Matushansky & Frolov, 2000). Scientific and methodical culture of the teacher and his methodical professionalism are in the focus of Russian studies of the last decade (Podpovetnaya & Rezanovich, 2012; Sergeeva, Uvarova, & Nazarova, 2002; Erganova, 2007). The proposed recursive methodical competency formation model takes into account leading approaches to the construction of the contemporary programs for teacher professional development and conditions that ensure the quality of implementing these programs. Such approaches have been developed both by the world scientists and Russian researchers (Hawley & Vallis, 1999; Batrakova & Bordovskii, 2009).

Distinguish the theoretical approaches that have been used in the construction of recursive model:

1) Andragogical approach (Knowles, 1980; Usher & Bryant, 1997), which is focused on organization of joint activities of the teaching person and adult students, who already have some knowledge, skills, and formed lifestyle. This allows each of the persons involved in the educational process to act under different pedagogical roles (consultant, moderator, tutor, and coach), and in our case, to master the above described methodical role.

2) Activity-related content of education and project-based approach, aimed at developing specific products of joint activity, sought by educational practice (Wilkerson & Giiselaers, 1997). Training programs are tailored accounting for the specific problems of the university: we are talking about the organization of internal practice-oriented training of teachers. The emphasis is made on collaboration between the teachers, having

different teaching and working experience, as well as different pedagogical approaches (Burbank & Kauchak, 2003).

3) The modular structure of the programs, which enables the construction of an individual route for trained teacher in view of his needs, professional interests and abilities.

4) Maximum use of software for computer-based training, allowing one to follow the interactive mode of learning.

Improving professional activity of a teacher in the Russian university can be carried out in several ways. The most typical are refresher courses and advanced training, officially organized by the University leadership. Currently, according to regulatory documents, program assimilation timeframe is 72 hours. Learning mode is no more than 36 hours per week. There are different forms of learning: complete termination of the work at the university during a training period; partial cessation of work; and part-time training. Proposed methodical competency formation model may be feasible in the context of the first direction, though it is more correlated with the concept of learning organization (Senge, 1990). In the context of this theory, the university faculty members form an organization that consciously changes its borders and reorganizes its functional structure to a fuller realization of its main purpose and goal. Exactly this model promptly meets the challenges of a rapidly changing information society.

5. Conclusion

The problem of quality implementation of CBE in Russian higher vocational education will continue to be relevant for a long time. Undoubtedly, the solution to this problem is related to the professional development of a high school teacher at any stage of his career (including postgraduate, assistant, and post doctoral stages). Experimental verification of the basic aspects of proposed concept and more detailed study of recursive methodical competency formation model of a high school teacher will be carried out at the Department of Education Philosophy and Methodology of the Ukhta Technical University.

We emphasize that the workplace of university professor, whether the audience, university laboratory, research library or his home desk, is a place, where methodical creativity is always going on. We are confident that the practical implementation of a recursive model will allow keeping the balance between teaching and research activities. Recursive methodical competency formation model encourages teachers in terms of their professional advancement. This means that the efficiency of their work will increase. As a consequence, the main result of their professional activity will be greatly improved: a graduate will become a truly competent and adequate to meet challenges of continuously changing society.

Well-known expression of Stanislaw Jerzy Lec, the poet and aphorist of the XX century, says: "One has to be very patient to learn patience". Paraphrasing this statement, we assert that high school teacher, to form his own methodical competency, must recursively deal in methodical activity, solve methodical problems, and create "methodical texts". And further, he must repeat again and again chosen rout on his professional self-development. In our opinion, recursive relation is well illustrated by painting "Drawing Hands" of Dutch artist M. C. Escher. This recursion will result in the formation of such a professional position, which will be based on the general orientation towards the solution to any methodical problems while implementing Competency-based Education.

Acknowledgements

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