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CREATIVE WORK PEDAGOGY IN THE CONTEXT OF MODERN TEACHING PARADIGM

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The article deals with the problem of creative work pedagogy in the context of modern teaching paradigm. The aim of the article is to consider possibilities of applying main provisions of the creative work theory supported by the Polish researcher A. Goralski and American creative work methodologist D. Poya into the practice of teaching physics taking into consideration some modern cognitive investigations of psycho-physiological characteristics of a human, in particular. The main objectives are defined as the theoretical analysis of scientific and pedagogical literature highlighting different aspects of the problem under research, and inquiry into the main tenets of the theory of creativity of A. Goralski that integrates logic, ontology, epistemology, psychology and creative work pedagogy. The authors present the basic provisions of the modern theory of creativity in the version of the creativity researcher A. Goralski. The ways of implementing key provisions of the theory into practice of teaching physics based on some results of modern cognitive investigations as well as recommendations of American creative work methodologist D. Poya are considered.

Key words: *creative work theory, creative work pedagogy, algorithmic and heuristic methods of teaching, conatus, creative work training.*

Introduction

Education is known to play an important role in the comprehensive development of the individual and is the process and the result of mastering the system of knowledge and skills by students. Today the tendency of transition from traditional "information– performance model to creative-search model in teaching natural sciences is becoming increasingly noticeable (Atamanchuk, 2010, p. 5). In complicated changeable life conditions it is just a creative person who is best focused, works better than others, is able to make the best decisions, being capable of generating and using novelty (new ideas and plans, new approaches, and new decisions). So the problem of departure from traditional teaching towards teaching creative work, preparing students for professional creative activity that *per se* is rather unusual – how to teach something you do not know yourself i.e. new, creative things – is of great current interest. In general interpretation, this problem has two facets: theoretical (methodological basis) and applied (forms and methods of teaching). In other words, it is highlighting theoretical and methodological fundamentals and using them as foundation of building concrete forms and methods of teaching creativity.

The aim of the study

The aim of the article is to consider possibilities of applying main provisions of the creative work theory supported by the Polish researcher A. Goralski and American creative work methodologist D. Poya into the practice of teaching physics taking into consideration some modern cognitive investigations of psycho-physiological characteristics of a human, in particular.

Theoretical framework and research methods

A. Goralski in his works (Goralski, 2002, 1998) considers creative work as a certain kind of handicraft or

skill pertaining to human activity that has its own traditions, mastery, corporate character, professional secrets and regulations that can and are to be taught. His creative work theory embraces some interrelated parts that accord with standard philosophical division: logic, ontology, epistemology, psychology and creative work pedagogy.

The methodology of our research comprises different theoretical methods. We have used the comparative-historical method; logical and comparative methods, methods of induction and deduction, content analysis etc.

Results

Creative work logic. The central notion of creative work theory is synthetic intuitionism that compliments analytical rationalism. The latter is well highlighted in the national literature. As to synthetic intuitionism it is: first, the way of performing discourse not with a person (as in the case of analytical rationalism), but with reality, and it is directed either to history or to future; at the same time it does not depend on space coordinates, that is, on circumstances; second, synthetic intuitionism lies in capturing "the clue", something that makes the synthesis possible and gives the variety of content, sensitiveness and openness of language ascribing to symbolic enthusiasm etc.; third, synthetic intuitionism leads to objectivation of its discourse and "clue" into certain image – expressive, universal (in space and time), archetypically obvious etc.

The student like a creator leads a certain discourse not with a person, but with some concrete reality filled with professional contents, solving problems algorithms, phenomena and notions etc. during the period of studies. The "clue" is the minimal chain of teaching actions created by the student that depends on the subject specifics, physics, for example, that is: task analysis, diagram, scheme, algorithms (approaches) of solving problems (morphological analysis, spontaneous group thinking, search matrixes, systems approach) etc. The solving process itself is the subjective discourse ("the clue"). It should be evaluated by the teacher.

Creative work psychology. Creative work is considered as the manifestation of transgression – the behaviour that steps outside the typical activity due to which new structures are being formed or old ones are being ruined, positive and negative values are being created that are the source of development or regression. We consider now the creative approach to solving problems.

Creative work motivation is the so-called "hubristic" motivation that is an attempt to confirm and enhance your own value. The student mind is the orientation system and will that perform leading functions playing a specific role in creative behaviour. The main inner (psychological) position of a person is characterized as being open to the whole world.

Creative work pedagogy. The central notions of creative work pedagogy are the teacher (master) as a means of creative work pedagogy and the interconnection student – teacher that is always individual and characterized by the positive synergy of compulsion. This interconnection is displayed both in the intellectual and emotional, or moral plane. It is critical for the student to get confirmation of the importance of his/her work and its results from the teacher (master). Thanks to the student the teacher has a possibility to check and develop his/her skill. Pedagogical ideal at that remains quite traditional. It is the student who has a desire to become a master, that is, a professional in his/her field and to work creatively on his/her own. The critical issue at that is that the teacher (master) can help a student to identify and develop his/her individuality.

In terms of creative work ontology the teacher's skill lies in bringing home to the students in different ways the necessity to perform academic professional tasks, the students being ready for that at the moment.

Creative work pedagogy is transformed into mass school pedagogy and is called upon to create a number of competencies set by the curriculum.

To solve problems of creative work studies it is necessary to take into account psycho-physiological preconditions of person creative potential development, memory, right and left hemispheres thinking, the rapport between the intellect level, knowledge, and creativity. Memory "is a very big part of talent. The phenomenon that we call talent or even genius depends to a high degree on the ability to use memory correctly in order to find the past, present and future analogies that are of higher importance for the new concepts development" (Blonskii, 2001, p. 105). The cognitive theory considers memory as a complex information system in which processing, saving and keeping information takes place. The logic memory is considered to be the highest stage of development when it is already difficult to differentiate it from thinking. In the process of developing memory is preparing to substitute itself for thinking. But thinking is developing only at certain, very high level of memory development (Blonskii, 2001, p. 241). The interrelation of theoretical and practical, logical and imaginative components of thinking is related to the functional asymmetry of brain. It is well known that the left hemisphere of brain is responsible for the language, analytical and successive information processing providing in such a way consecutive analytical thinking. The right hemisphere controls sensory and motoric functions, operates the imaginative information, manages skills related to visual and spatial experience. It is a medium of the unconscious strength of creative person; it has lower ability to catch the plurality of relations and organize polysemy of context. It is the

creative process that creates polysemy of context. It needs less psycho-physiological efforts and lower level of additional brain activation than mono-semantic context creation. Both styles of thinking in people with low creative potential need equally high brain activation. Easy transfer from abstract to concrete thinking and vice versa indicates good right and left hemisphere thinking components, integration, flexibility of thinking, capability to reject stereotypes and skills to break the psychological barrier of the standard approach to phenomena, and this is the first step to creativity. In early childhood, imaginative thinking prevails, but all our education system is conducive to the development of formal logic thinking and acquiring the ways of one-meaning context creation. It can be treated as a systems mistake as the more efforts are applied in the process of teaching for logical semiotic thinking, the more efforts are needed then to overcome its limitations.

The interrelation between the intellect level, knowledge and creativity is also complicated. Ex facte it is obvious that keeping big amounts of information in memory enables to find out different approaches to solving problems. However, the investigation of students' activity in the process of teaching showed that those who mastered much knowledge become competitions and contests winners mainly because of their erudition that itself becomes an instrument of limitation directing to the stereotype problem solving. "…high (even very high) level of intellect does not guarantee creative achievements. One can be an intellectual but cannot become a creator" (Druzhynin, 2007, p. 171). Sometimes students that have comparatively less knowledge are able to work creatively, catch problems as if from outside, to show the ways of their solving, outline general features of expected new results.

In the applied part of A. Goralski creative work theory the main didactic means of creative work teaching are "creative work models" and "reasonably selected sets of tasks'". The process of teaching depends on many factors that influence knowledge acquisition, among them being the personality of teacher and individual perception of the new information by the student. If a teacher (master) is absent its role can be played by the models of creative work that are presented in the way of didactic materials. These are the models of didactic creative work done by scholars, teachers, and methodologists, e.g. textbooks, manuals, methodological materials etc. (Shvai, 2012, Shvai, 2011). They can carry out the function of mediator in the academic materials exchange between a teacher and a student, give a possibility to take into account individual characteristics of each of them, for example, the work tempo, temperament, mood, ability and readiness to work, motivation and the creative work level.

Epistemology of creative work. From the point of view of epistemology and heuristics, creative work of the student is a subject of reflection according to the hypothesis that we possess only the basic knowledge on creative work and creative activity, that is, we apply different strategies and instruments for their development.

Methodology (or meta-methodology) of creative work. The central link of this proposition is meta-method or the method of methods, i.e. designing the methodological system of the subject, the model of pedagogical interaction in the process of education. A completed methodological system is properly realized in the way of teaching model (physics) with the help of appropriate creative work pattern – the didactic materials.

These postulates are directed to the comprehension of physics teaching modern paradigm in which a proper place will be occupied by personality development, creative potential, in particular. In didactics, the following main features of knowledge are differentiated: completeness and depth, systems character and efficiency, concrete nature and generalization, awareness and strength, flexibility as an ability to reject stereotype mode of thinking and to come over the psychological barrier of the standard approach to phenomena. The last is the first step to creative work. The ability to marvel the world is one of the conditions of creative life.

A big arsenal of didactic tools should not be used for the creative abilities development. To work creatively means to apply such didactic approaches that make the process of teaching more interesting and effective than a traditional one. It is also related to improvement and modification of content and teaching methods that stimulate motivation for studies. Contrary to the creative studies creative work teaching as creative personality building is directed to the development of individual ability to think and act creatively. Creative work instruction also provides for creative teaching as creative work stimulation exactly needs availability of teacher creative abilities. So the teacher that teaches creatively does not teach creativity, but the one that teaches creativity simultaneously realizes creative instruction. It is impossible to develop creativity without creative application of methodical systems, strategies, without new and original didactic tools development, without innovative didactic approaches.

Pedagogy of creative work is directed to creative abilities development. One of the main didactic factors of creative abilities is creativity training that "provides necessary skills for the creative work that are indispensable in creative activity" (Goralski, 1998, p. 18). Creativity training that is aimed at creative abilities development of students necessary for the future professional creative activity should be carried out as

group classes. Creativity training in the process of physics teaching is a system of didactic group classes that are structural components of the academic process in physics; it is conducted with the aim of developing the creative potential and creativity of students, designing their motivation and life experience, creative approaches to problems solving, ensuring balance between cognitive and affective personality development.

Use of knowledge in innovative conditions means for the student that he can gain knowledge and use it in the situations outside the textbook or lecture. However, given the A. Goralski statement that what is creative is new and valuable, that is to act creatively means to set a goal and get new and valuable product, from the student's perspective each solving of the so-called "creative" problem is exactly the process we talk about. Natural sciences teaching methodology determines different ways of logic thinking development, but there are no described strategies of right hemisphere thinking development, of teaching based on images. Let us consider some ways of solving this issue concerning problem solving in physics in secondary, of general education establishments (an attempt of didactic creative work theory application in the process of physics studies). The physics didactics does not outline the teacher's work system for skills designing to solve problems by the pupils. They do not study methods of solving problems, but intend to solve them by "try and error" methods seeking to find relevant formula that leads to the answer. Such behaviour according to A. Goralski is the conatus, or the intention to do something at the spur of the moment, this being an absolutely ineffective method of problem solving. The methods in general are characterized by the space of solving problem methods, namely: a set of algorithm methods, conatus, or a set of conatus methods, among them heuristic methods space is being distinguished (Goralski, 1998, p. 23). The necessity to engraft heuristic thinking skills together with logic thinking habits is the main thought of D. Poya's works. "Thinking can be called productive if it leads to concrete problem solving, thinking can be called creative if it creates methods for future problems solving. The more the number and the wider the variety of problems to which the created strategies are applied, the higher the level of creative thinking is" (Poya, 1976, p. 274). It is implemented by him via didactics through the detailed system of stereotyped instructions (bits of advice – recommendations or questions) with the help of which the teacher can appropriately direct student's efforts that in turn facilitate developing his/her learning independence. D. Poya's methods can be applied to teaching physics problems solving. "…the art of solving problems gives us a chance to create certain kind of mind in students and engraft certain notions that are a general education critical component" (Poya, 1976, p. 315).

Let us address once more the issue of problem solving methods space. The algorithm trains to act according to the pattern and it is "characterized by certain effectiveness and narrow specialization" (Goralski, 2002, p. 23). However, if spaces that embrace algorithmic and heuristic methods touch one another, we can consider their interdependence. The algorithm application demands specification of knowledge concrete definition, knowledge transfer to the similar or new situation and this teaches the student to study. Thus this is not a mechanic process, it needs thinking. Our knowledge about peculiarities of mental activity of the person who is solving the problem is still insufficient. Technologically, solving problem process can be considered as creative activity training, the elements of which can be used while studying physics, for example:

– "Let us observe the diversity of the world" – the need of performing the exercises of this type is caused, "on the one hand, by the necessity to break the stereotypes of teaching situations perception having been formed during our studies (at high school or higher school) and during solving standard life problems, and, on the other hand, by the necessity to think freely, notice plurality and integrity, likeness and difference; behaviour and activity schemes (well noticeable and less visible), variety of ways leading to the aim as well as versatility of actions and its results" (Goralski, 1998, p. 24). Such element of creative work training gives a possibility to develop right hemisphere thinking.

– Another element of training – "try something different". The task may lie in using the same measuring devices for finding different physical values or vice versa – different physical devices for measuring the same physical value. For example, in what way can you use a barometer for height measuring above the Earth? One can do it via the pressures difference or one can throw it from a certain height and take into account time of falling.

– One more element – pro and contra. The exercise is the tool of distancing from himself/herself by means of very radical procedure. For its fulfilment the group of pupils is divided into two parts: one group takes part in defence, another group is opposing during the theme discussion. This exercise can be successfully used in class as a didactic play.

– A little bit of imagination – "this exercise is meant to develop imagination that is never too much" (Goralski, 1998, p. 30). This can be attained by the 'broken" physical experiment. In the process of experiment demonstration the teacher takes a pause and proposes the pupils to predict its continuation or the experiment results.

Aiming at creative thinking formation it is necessary to begin from the simplest thinking actions and habits. In teaching physics there are mostly used instructions of the algorithmic type rather than algorithms. The system of such instructions does not regulate all the actions in a tough way. Some of them determine general trends of problem solving plan search and give space for self-guided activity. The algorithmic method prepares pupils for creative problems solving due to the fact that in such a way there are formed thinking actions and habits which in future the pupil will carry out automatically moving from solving typical problems to solving creative ones. The teacher uses models of creative work; in the ideal situations he/she creates them himself/herself taking into account individual possibilities of pupils and predicting possible spheres of their interests. For the theme study the teacher chooses some really important problems connected with everyday life experience, predicting that they will cause interest on the part of pupils (students). He/she discusses the problem condition very succinctly and slowly. The teacher helps the pupils (students) ask questions or formulate the questions to be asked by the students. The teacher does her best to change the stereotyped vision of the world. In the ideal situations the pupils (students) solve the problems on their own. In such a way the problem becomes a typical example, the pattern for the whole branch of science. This reflects "the ideas of paradigmatic teaching – the teaching in accordance with patterns" (Poya, 1976, p. 314). In the system 'teacher – pupil" a constant dialogue is taking place. There is required the basic knowledge that has been created in the process of theory learning and by algorithmic methods. The teacher starts with simple problems. The question exchange is welcome. What process or phenomenon is considered in the problem? What functional dependencies exist between the unknown and other data? Do we know appropriate formula? Are all other physical values but the unknown the data? If not, then how they are functionally connected within the addressed laws and phenomena? Can we write down an equation or a system of equations? It is worth mentioning that a general model of solving, an invariant one, is present in transition to solving of every subsequent class of problems. The variation model, on the contrary, is a model of questions and instructions of the teacher in the obligatory dialogue teacher – pupil, for example: Did you solve such or similar problems before? Is it possible to find the unknown from the equations? Are all data used in equations? Have all the essential notions incorporated in the problem been used? What additional equations can be used to find the unknown? What alternative methods can be used to solve the problem? Is it possible to solve this class of problems differently? What is the best method? Could it be possible to use this method of solution for other problems? What elements of solution can be used for other problems of this class? The algorithm should not be overly imposed on the pupils. A certain type of algorithm proposed by the teacher is discussed as to its use for solving one-two problems. Having understood the general logic of thinking the pupils (students) perform every operation consciously. But the range of problems is very big and it is impossible to design teaching algorithms for all types of problems. That is why a teacher can use a set of algorithmic heuristic methods.

Conclusions

Thus the basic provisions of the modern theory of creativity in the version of the creativity researcher A. Goralski have been considered. Taking into account the main psychophysiological (cognitive) assumptions there have been outlined the ways of implementing forms and methods of teaching creativity, with teaching physics being taken as an example. Further research, as well as arrangement of the system of problems and questions, can be directed to creation of new teaching technology being qualitatively different from the traditional methodology and directed towards forming the creative personality. The system of preparatory tasks makes it possible to generate creativity and teach creativity by solving physical problems, despite the fact that the novelty of the product can be subjective, relative, and significant only for the person who creates.

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