EDUCATION PRACTICAL COMPONENTS INNOVATION COMPETENCE IN THE SCHOOL STUDENT

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Today, when Russian economy is firmly on the path of innovative development and national innovation system has become a developed infrastructure, no one in doubt that these circumstances, with the integration of the industry modernization, will provide our country a technological breakthrough. Under these conditions, the main challenge for the higher school of Russian Federation, is to prepare professionals to the future innovation engineering (IE). The present article is the succession of previously developed methodical system for national research universities students to form their innovation engineering competence (IEC) and aims to increase the efficiency of its realization.

In recent authors' works [1, 2], the hypothesis that students training effectiveness for engineering innovation in IE teaching increase if it implemented in phases, with the consequent increase in complexity of tasks with the deepening of the IEC activity component has been formulated. To prove this hypothesis a pedagogical model was developed, which includes the objective, conceptual, informative, technological and diagnostic components (Fig. 1).

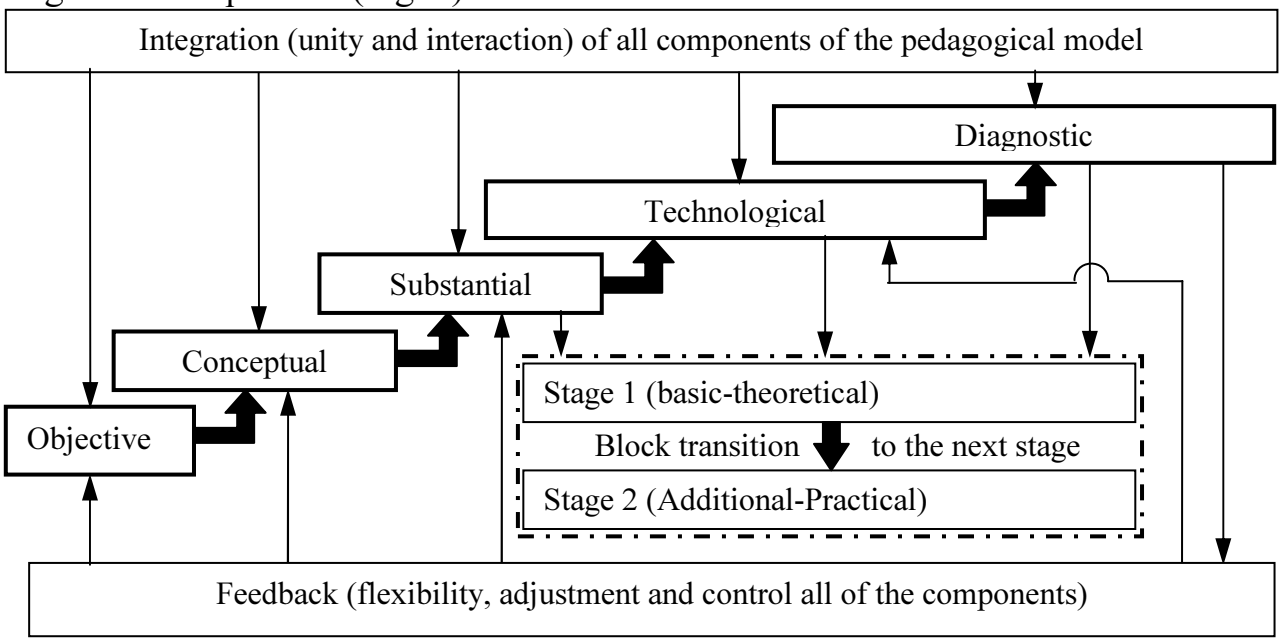

Fig. 1. Block diagram of stage formation competence in innovative engineering activities (CIEA) a pedagogical model

To implement this model the very studying is the first (theoretical) step [1, 2, 3]. The second (practical) one could be such process as: research work of students in

scientific societies, design offices, student competitive meetings, high-tech science labs, etc. Foe this purpose we have chosen summer academic schools for graduate students and young scientists. It should be noted that such activities as summer research schools have their own long history, and are taken place by many of the leading universities in the country [3, 4, 5].

Shown in Fig. 1, the components of pedagogical models are fully described in our earlier papers [1, 2, 3]. In this article, we would like to pay particular attention to the technological component (Fig. 2), which defines the success of the model.

This component includes methods, forms and means of learning [2, 5, 6, 7, 8]. The schools used the traditional methods of learning: information, illustrations, reproductive, search, problem, research. However, the problem, search and research ones are focused, since in academic disciplines, students had already been formed primarily motivational, psychological and partly qualifying components of IEC [2]. In addition to traditional and innovative forms of schooling such learning forms as individual supervisor consulting, students self-working (SSW) under control of supervisor, the SSW in the team and their combinations have been added.

All of these methods and forms have been implemented in business game "Company" [2], developed by the authors on the basis of innovative method of learning within the team (Figure 2), which has been modernized and adapted to the conditions of the summer research school. As well as at the university, a group of students (6-7) organize their own "company", which worked throughout the school study, however, in contrast to the traditional study, team work was carried out not only in school, but while participating in all creative competitions, sporting and other events. The main stage of the business game also was the development of intellectual protection mechanism (IPM: inventions, utility models, industrial designs, trademarks). Project defense also took place in the form of presentation of each "company", which has been discussed by a group of experts and members of other teams.

To the traditional learning tools [2, 3] in the described school, a series of specially selected art competitions and sporting events have been added. All of them were aimed at rallying the team in solving the problems, to identify the true leaders, forming ability to act quickly and make decisions, and then take responsibility for them. Furthermore, creative competitions contribute to the development of students' creative potential, which is the basis of IE.

Throughout teams work, there has been a cumulative points system (for individual and for team), when each team member has been responsible for their actions to the staff and for the team as a whole, in the need of mandatory decision in extreme conditions (stress situation, time limit, responsibility in decision-making, etc.). It is also one of the main motivations of active, responsible and productive work.

As rightly pointed out in the works by Naumkin N.I. [1, 2], one cannot use in teaching practice certain technology or methodology for training, they are necessarily based on the integration of several scientific and methodological theories (Fig. 2). According to the special conditions of training in summer schools identified in the paper [3], we conclude that specific technology should be unified, which takes into account all of the above aspects.

Based on the analysis of didactic features to train scientific and technical creativity, N. Anisimov [10] indicates that such conditions need for the system design of teaching creative problem solving. It should be carried out on the based of methodological approach that increases social importance in achieving innovative solutions, to

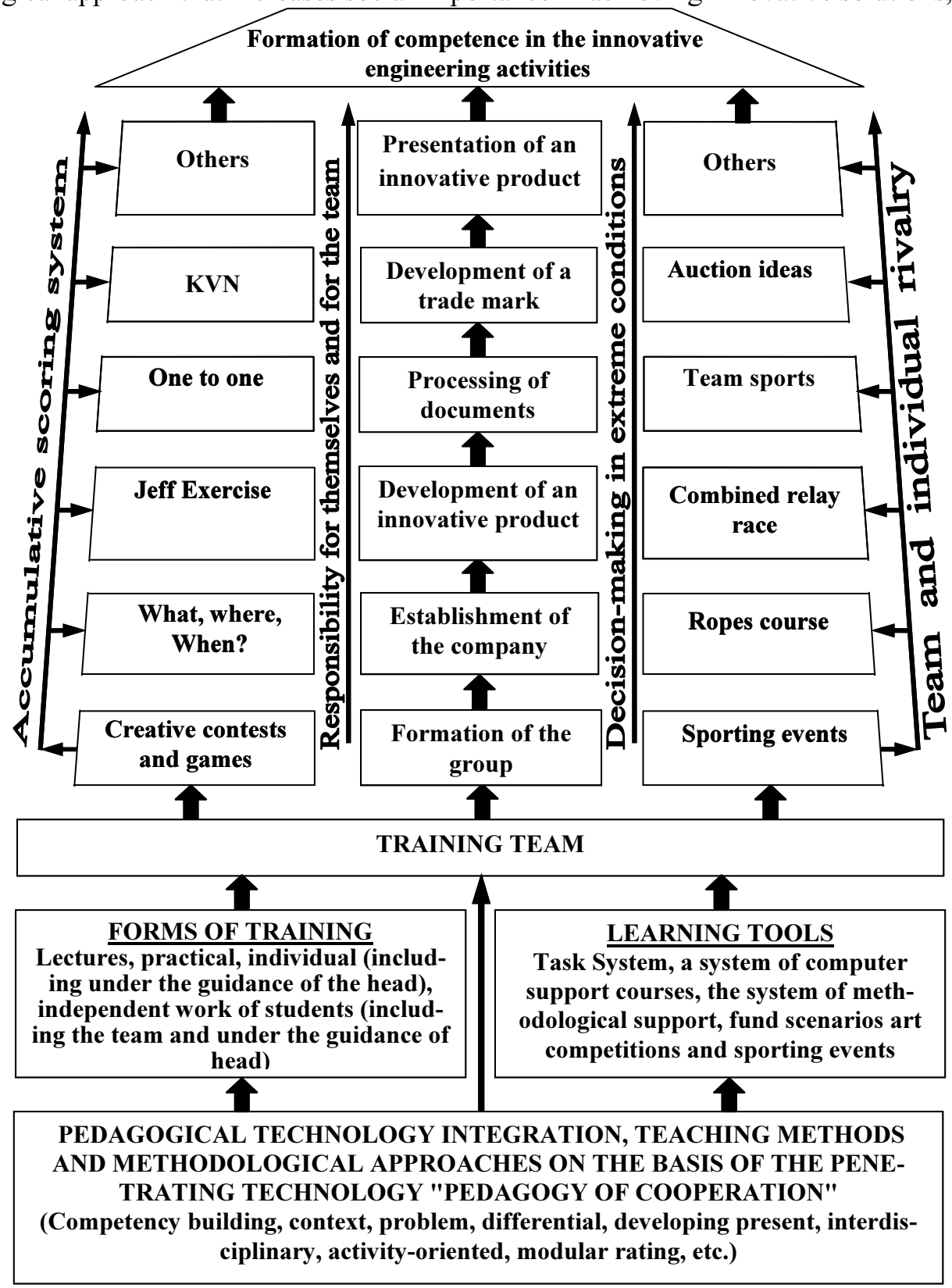

Fig. 2. Block diagram of the technology component.

achieve such an intellectually-communicative conditions for creative activity in which the student would be able to implement activities, equal to creative nature of the problem.

Such technology should absorb positive previous experience and must comply with a new understanding of objectives creativity learning, and is based on the activity and student-centered approaches. This one offers the training innovative and inventive activities technology which is developed on the basis of psycho-pedagogical approach of joint productive activity (JPA). JPA is the development of active work principles of the individual student, during interaction, communication and development of relations between all participants of the educational process. The main principles of this approach are:

1) the introduction of productive creative problems at an early stage of learning and sharing their decision;

2) the staged development of changing forms of cooperation between teachers and students in accordance with the levels of mastery of productive ways to tackle problems;

3) the gradual movement of the student to self-regulating activity in the process of problem formulating and solving.

The developer of presented technology rightly notes that learning technology should be based on pedagogy of cooperation. This fact is confirmed by other researchers, for example, the concept of partnership teachers and students. This concept developed by American educators H.B. Becker, R. Christensen, S. Brody, I.A. Parrish [10] and is based on joint work of students and teachers as fellow partners in the overall work. It involves the joint formulation of the problem, as well as sharing of it decision. At the same time, students choose their methods of work and set deadlines. Such training significantly increases the creativity of the educational process, stimulates creative abilities of students, liberating thinking and relieves mental stress at work.

The mentioned pedagogy of cooperation was proposed by a group of researchers led by S. A. Amonashvili [9]. As the A.P. Pelevina states [1, 2], it is one of the richest and comprehensive teaching generalizations, which combines the best traditions of Soviet, Russian and foreign pedagogy. It is also "penetrating" technology since, in one way or another, comes into many modern educational technology. In accordance with its basic principles, the situation when the teacher is proposed as the subject of the pedagogical process, and students is as an object of it, is replaced by the idea of the pupil, as the subject of his "study". This training is free of compulsion, advance training, in which there is freedom of choice and joint activities. Two subjects of the same process should work together as partners, colleagues and make an alliance the senior and experienced with less experienced, and none of them should be placed above the other. In the context of higher school, students themselves choose their methods of work on the problem and set deadlines. Such training significantly increases the creativity of the educational process, stimulates the expression of students creative abilities, liberating thinking and relieves mental stress at work. As the developers of this technology states, the main reason limiting its widespread introduction in teaching practice is the students' lack of the same desire and motivation for its de-

velopment, as well as the teachers. Such reason lacks in students training system in summer research school in which the composition of the audience formed voluntary and at the request of the participants.

Thus, the experience of summer research schools has shown the following results:

1) during the training stage, the competence in innovative engineering can mostly formulated in summer research schools, because it combines a form of active learning, leisure, and intensively training;

2) as a second (practical) stage of IEC formation, regional summer research school enhances the effectiveness of training students for innovative engineering activities;

3) improving the functioning of summer research school is provided with new integrated educational technology, which is characterized by pedagogy of cooperation.

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