

THE STRUCTURE OF COMPETENCE IN INNOVATIVE ENGINEERING

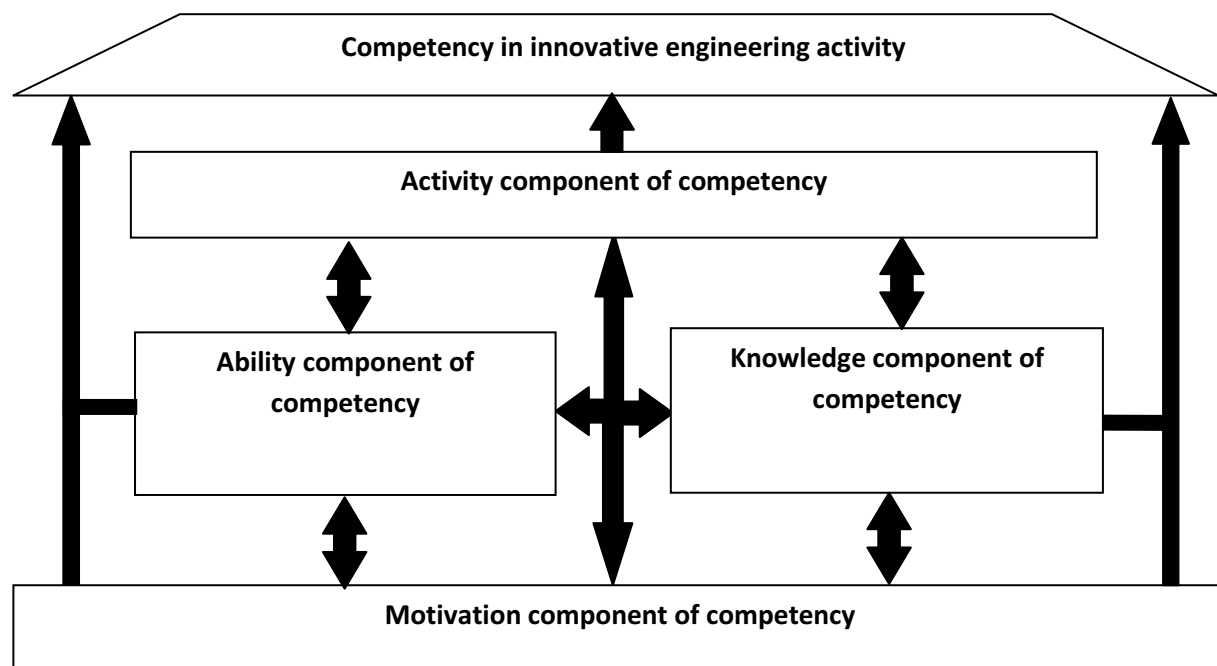
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In this study the concepts of "competency" and "competence" are concretized and structured. It was done within a research carried out at Ogarev Mordovian state university; the students of national research universities are being studied on competence of innovative engineering activity formation (CIEA).

Nowadays there are many definitions of "competence" and "competency" [1], in relation to our research, the most acceptable definition of competency was given by Yu. G. Tatur [1]: "Competency is an integrated trait of personality, that characterizes its aspiration and capability (readiness) to realize the potential (knowledge, abilities, experience, personal features etc.) for successful activity in a certain area". And competence was given the following definition [1]: "Competence is a set of the interconnected internal means of activity of the subject (knowledge, abilities, skills, specific abilities, methods of decision-making and ways of activity), subjects set in relation to a certain circle and processes, necessary for high-quality activity in relation to them". We will adhere further to these definitions.

Taking into account the above-mentioned and on the basis of the researches [5, 6, 7, 8], carried out by the authors while training national research universities students for the innovative activity (IA) [3, 2], competency of innovative engineering activity is presented as a set of components: knowledge, activity, motivation (person's needs and society's needs), psychological (development of abilities). These components are structured in the form of the scheme presented in picture 1.



Picture 1. The integration of competency components in innovative engineering activity

According to the scheme, first, all these components are in close integration; secondly the motivation component is the basis of ability, knowledge and activity components formation; thirdly, the activity component is a realization tool for motivation, knowledge, ability components; fourthly, all these components form CIEA. Their short characteristics will be stated.

CIEA motivational component. For CIEA formation the following actions are necessary: 1) ensuring motivation; 2) determination of a set of requirements of IID; 3) formulation of the purpose which needs to be reached as a result of activity; 4) identification of the object, which is the activity to be carried out on; 5) formulation of activity structure and requirements to its implementation; 6) choosing external technical means and application of internal means acquired by the subject.

The motivation is defined by psychologists, sociologists, philosophers and other researchers differently. The motivation for innovative activity, from our point of view [1, 2, 4] is a set of motives causing activity of the subject, production or society in a certain direction. The set of motives we will consider as: 1) person's needs that brings a subject to a condition of activity; 2) requirements of society – social values and ideals; 3) incentive – the means that strengthen power of motives; 4) interest – appeal of IEA. The motivation can be internal and external, positive and negative.

The interest is an emotional state which motivates research activity, by special attention to an object of research. The appeal of innovative engineering activity causes interest in NRU students as it is capable to satisfy all needs of a person and the society, moreover it has political and economic support.

The knowledge component of CIEA includes the knowledge gained at studying the following cycles of disciplines: the science; the interdisciplinary; all-technical, defining the width of vocational training; special, forming knowledge in a certain area and defining depth of vocational training; others – humanitarian, social, economic, legal.

The psychological component of CIEA. This component is defined by the main properties of nervous system and abilities of a student (intelligence, trainability, inclination, the attitude towards the teacher, creativity, communicativeness). We will consider these characteristics of the psychological component.

Intelligence is ability to apply the knowledge and the solution of tasks on the basis of the available knowledge, promoting successful activity. The intelligence is a set of all informative functions of a personality: from feeling and perception to thinking and imagination. J. Guilford [9] introduced concepts of convergent and divergent thinking, as intelligence components. Convergent thinking is ability to find the only right solution correctly and quickly. Divergent thinking is a process of promotion of various and equally correct concerning the same object.

The trainability is ability to acquire new knowledge and skills fast and easily, which promote successful activity. Success of trainability is influenced greatly by a motivational component (interest, incentive, etc.) and intelligence. High I.Q. without motivation doesn't guarantee successful trainability; often not a bright student reaches tops in scientific activity in future. However people with intelligence below an average are never among advanced students [10].

The inclination is the aspiration, the increased inquisitiveness, inclination of the person to a certain kind of activity (invention, commercialization, etc.), that is a guarantee of their abilities development in this activity. However, not always an inclination is true, sometimes an inclination is a result of a suggestion or auto-suggestion; without potential opportunities, it is called false or is called a hobby. A true inclination is distinguished by fast achievement of considerable results [9].

The attitude towards the teacher is a subjective opinion of the student which consists of qualities of the student: ideals, moral principles, background; and the teacher: morals, social status, and professionalism. Unfortunately, recently the social status of teachers has worsened considerably; partly it has caused the disrespect for teachers. The attitude towards the teacher influences the trainability of students greatly. If the teacher has authority over students, progress considerably increases. In this regard the teacher has to be an active subject of innovative system.

The creativity [10] is ability to transform available knowledge, i.e. ability to the creativity. It is characterized by ability to find a solution of tasks in an uncommon way, imagination, and achievement of the purpose. The American psychologist J. Guilford became the founder in the field of creativity; he distinguished 16 mental abilities characterizing creativity, as: fluency (an amount of the ideas arising within a unit of time); flexibility (ability to switch from one idea to another); originality of thinking (ability to produce the ideas which differ from conventional ones); inquisitiveness (hyper sensibility to the problems not causing interest in others); irrelevancy (logical independence of reactions from incentives).

The communicativeness [10] is a characteristic of a personality defining possibilities of communication, and corresponding manifestations of the personality (sociability, isolation). Communicativeness assumes an exchange of thoughts, information, feelings. Communicative abilities in the sphere of business communication demand social experience, knowledge of cultural norms and rules, traditions, etiquette in the communication sphere, and following them. Communicativeness is formed of the following qualities of the personality: readiness to perceive new, tolerance, the benevolent attitude towards people, erudition, self-confidence, oratorical skills, ability to persuade, physical appearance, sense of humor, etc.

The activity component of CIEA. The knowledge, psychological and motivational components of competence of IEA find practical application in an activity component which is presented by competences of IEA as a set common cultural (CC) and the professional competences (PC) which have been marked out below.

The presented structure of competency of innovative engineering activity, the competence presented in the Federal educational standard, and also the previous researches [1-7] conducted by authors allowed to mark out the following competences necessary for NRU students of NIU to form the competency of IEA, within the activity component: 1) ability to use normative legal documents; 2) ability to allocate a problem; 3) ability to set a task; 4) ability to synthesize the solution, to invent; 5) ability to visualize (to use the imagination); 6) ability to operate results of intellectual activity; 7) ability to master the off-the-shelf solution, new equipment and

technologies on a legal basis; 8) ability to work with patent and non-patent information; 9) ability of the analysis of a technological level of object (goods: a product, work, services); 10) ability to analyze novelty of an object (goods: a product, work, services); 11) ability to define the tendencies of an object development (goods: a product, work, services); 12) ability to define the conditions of the competition in a certain market; 13) ability to organize team work; 14) ability of business communication; 15) ability to commercialize an off-the-shelf solution. Further researches of NRU students training in innovative activity have to be directed on effective formation of these competences.

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