The formation of students' engineering thinking as a way to create new techniques, technologies, materials

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Abstract. Engineering thinking is regarded as the quality of the person, which is stimulating the human need for the creation of new techniques, technologies and materials. Applications in the study of competence approach allows us to consider a professional thinking as one of the core competencies required for successful engineer innovations in mechanical engineering. The author's definition of professional engineering thinking is presented. The ways of its formation at students of technical fields enrolled in university courses are illustrated

In modern conditions of rapid aging of knowledge engineer's professional mobility is defined by personal qualities. An essential quality of personality, which is stimulating his need for the creation of new techniques, technologies, materials could be professional engineering thinking. Competence approach, on which modern educational standards are based, it can be considered that professional thinking is one of the core competencies required for successful engineer innovative developments in the field of mechanical engineering.

Professional thinking is generic with respect to the whole group of selected forms of thinking in the literature related to a particular profession or group of professions. Its specificity is manifested in the activities and tasks determined by the content, problem situations that can be solved on a professional stage career path. This is the content side of professional thinking and engineering as well.

For our research of interest to the following understanding of the essence of engineering thinking. Engineering thinking is a specific mental activity, in which the reflection and creative transformation in the human psyche phenomena of engineering design, construction, creation and development of new techniques, technologies, materials such as social functions, as well as a subjective construction of the engineering process in accordance with the social objectives of vocational education .

Features of professional engineering thinking caused by the specifics of the functions of this thinking. When performing certain functions of an engineer thinking it is intuitive and practical, performing other - research.

Formation of the students enrolled in technical fields, engineering thinking in the learning process in the classical university is a lengthy process of gradual implementation of a number of interrelated

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milestones. Today within the competence approach invariant system of intermediate objectives is to require a gradual transition of mental activity of the future engineers with the reproductive level to the creative activity of the creation and development of new techniques, technologies and materials. Such a transition requires familiarizing students to the analysis of contradictions and formulation of problems, hypotheses, their justification and proof in explaining the technical processes and phenomena.

This multifunctional and gradual process can be carried out as follows. When using a university professor explanatory and illustrative method, students follow a course of reasoning teacher. The emphasis is on the logical structure of explanation of the essence of the process or phenomenon. Further, the application of the problem of presentation of the lecture material, students are involved in the formulation of problems at the beginning of lessons, as well as finding solutions to the problems with the help of a teacher using appropriate methods of scientific reasoning (analogy, inductive and deductive assumptions, modeling, thought experiment [6]). When using more complex partial retrieval method (heuristic conversation) students together with lecturer analyze and generalize the experimental data, formulate hypotheses, conjectures to solve the problem, explain and prove the hypothesis of theoretical and empirically. The highest level of search can be achieved independence of students in the classroom, carried out by research.

As the integration processes in vocational education has always attracted the attention of teachers and researchers [2, 7], separately it should be noted working out special methods of solving experimental and computational engineering problems on the basis of interdisciplinary connections, systematic implementation of which learning is the basis for the creation of integrated educational and informative technical problems . On the theoretical and practical lessons in the process of solving these problems should also apply various methods of scientific knowledge with the gradual nature of the complication of tasks to be done by students. Otherwise, organize mental activity of students in the classroom (for example, energy-saving technologies) should be such that in the process of analyzing the students contradictions create a practical problem situation, they would arise subjective state of intellectual puzzlement and desire to get out of this state. We believe that the problem situation as a certain structural component of creative thinking is an efficient unit of analysis is the level of professional thinking of students of Engineering.

So, a special work on formation of students' engineering thinking, involves a problem of lectures in which students get acquainted with the methods of analysis of problem situations encountered in practice, setting the logic of engineering problems and ways of solving them. In order for students to participate in solving the problems of the lecture, the teacher is required at the same time outlining the lecture material to solve a number of problems. First, present the facts without a detailed explanation in logical terms "reasoning" presentation, which stimulates mental activity of students. Second, to control cognitive activity of students during a lecture. Third, clarify the ways in which the problem is solved lecture. There is a marked contradiction between the requirements for the organization of problem-based learning in a lecture and the real possibilities of their implementation in a lecture at the university. To overcome it requires a specific approach to the development of problem lecture. It should take into account four aspects: general didactic, informative, teaching and learning and educational.

Consider obschedidakticheskie problematic aspect of the lecture. By the nature of the interconnected activity of the teacher and students of a problematic presentation takes into consideration characteristics of productive thinking of students [1]: the creation at the beginning of the lecture the problem situation, based on its analysis and identify contradictions formulate problematic issues to find ways to solve the problem due to the reformulation and hypotheses, choice and prove the most faithful to the hypothesis about the way to solve the problem. Taking into account these features of productive thinking in presenting the material and activation using heuristic methods of mental activity of students, aimed at addressing the lecture provides a problematic approach to the presentation of the lecture material.

It is necessary to distinguish between substantive (analysis of one of the problems of science and practice, such as the problem of obtaining products with high performance [4], the formation of a regional system engineering [3]) and methodological (application of the method of presentation of the problem) side problem lecture.

Mental activity stimulates the students as the use in the educational process of design training (more in [5]) and the method of hypotheses. This requires a combination of presentation lecture topics with logical assignments to students. These tasks can be called didactic methods of control anticipatory cognitive activity. For example: 1) The teacher presents factual material, students are invited to put forward in the course of the lecture series of particular assumptions that are integrable in the final stage in the general hypothesis. Last checked generalization that makes the teacher at the end of the lecture; 2) the teacher at the beginning of the lecture the general hypothesis put forward on this problem, in the course of the lecture, students supplement and clarify the hypothesis; 3) at the beginning of the lecture, after the formulation of the problem formulated two conflicting hypotheses, reflecting the contradictory nature of the process or phenomenon being studied. Next, the students followed the course of the lecture, dialectically synthesized these hypothetical statements and make meaningful generalizations.

Thus, the communion of future engineers to creative mental activity on creation and development of new techniques, technologies and materials based on the realities of today through the analysis of contradictions, and posing problems, hypotheses, their justification and proof.

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