Modeling the Professional Competences Building Process in Engineering Higher Education Establishments

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Abstract

This article considers the issue of modeling the process of building competences of a prospective engineer. The authors have shown a way to enable developmental teaching to comply with requirements of competence-based engineering education which is performed through innovative efficient ways. The article suggests that in the framework of reproduction methods the objective of competences building can never be attained. The authors believe that a competent specialist can be formed through consciousness development. This paper proposes a range of principles governing the process of professional competences building.

Keywords: professional competences, engineering education, developmental teaching, conditionally appropriate translation.

1. Introduction

The present social and economical environment imposes new requirements on graduates of engineering establishments (Chuchalin, A, 2006; Shadrikov, V., 2004). Nowadays one of the main university's objectives is "to train highly qualified specialists in a particular industry of professional activity. On the basis of general education such training forms professional knowledge, personal and social qualities that allow most fully realize themselves in specific types of work" (Martseva, L., 2015, p. 12). In the course of elaboration of its current development policy the Association for Engineering Education in Russia considers engineering education to be the innovative competence-based education. Within the scope of studying a pedagogical innovation concept in a higher school, researchers note that "Pedagogical innovation in a university context is characterized by an intentional action that aims to improve university students' learning in a sustainable manner" (Walder, A., 2014, p. 197). However the study of prospective engineers training indicates that its level doesn't fully satisfy the current requirements. The existing educational system doesn't provide sufficient conditions for personal and professional development of prospective specialists, creative fulfillment and competences building. In a number of cases this system aimed at conventional teaching process's results such as knowledge and skills, can't train a student to integrally solve real-life and production problems. Meanwhile the objective of modern engineering education consists not so much in imparting system knowledge and skills in a certain field, as in developing skills for their continuous acquisition and active use for current problems solution (Tompkins J., Laslovich M., & Greene, J., 1996). As a result it is necessary to emphasize the developmental function of education aimed at harmonious personal and professional development of a graduate and competences building.

The stand of the Russian engineering academic community is reflected by the search of innovative teaching solutions which will provide for manifold increase of efficiency of the educational process in a higher education establishment and the creation of new educational models and technologies. Nowadays all over the world engineers training is subject to rather drastic switch from "the school of memorizing" to an establishment where a student is taught to work with his own consciousness, mind and experience (Shershneva, V., 2008; Montier, R., Alai, D., & Kramer, D., 2006). The engineering education doctrine says that «transformation of the engineering education system into

environment for mastering ways of cognitive and engineering activity, communication and engineering culture fundamentally changes the idea of a higher education establishment and its educational and upbringing process. With this regard the key line of engineering education development is individual arrangement of student's work during the whole period of his study within interdisciplinary practice-oriented groups, smooth involvement of students in dynamic creative activity and provision of their large-scale participation in scientific research work. These factors should predetermine the evolutionary switch from teaching process (the school of memorizing) to science-based educational process in engineering education" (Pokholkov, Y., 2012).

Such an important stage of engineering education modernization causes the need to redefine the essence of the learning process. The problem is that within the framework of educational practice a new pattern of engineering education should be implemented; the main outcomes of this pattern are general and professional competences of a graduate, while constructs of the competences-based approach can't be fully put into action in the framework of the current educational system in an engineering establishment. A well-founded strategy of changes requires new approaches to be found with regard to setting forth objectives and choosing content, methods and organizational forms of training a prospective specialist. These approaches should be oriented at consistent building of the required competences. However, it can be asserted that in the educational science there are certain theoretic pre-conditions for elaboration of a new concept of educational process organization in a higher education establishment; this concept should be able to serve as theoretic and methodological tools of competences-based education (Sosnin, N., 2007; Mirabile, R., 1997). All the above said predetermines the fact that the issue of modeling the professional competences development in an engineering establishment is started to be considered *in due time*.

Gnoseological notion *modeling* describes one of the ways of cognition permitting to apply the results gained in the course of pattern generation and examination, to an original on the ground that the pattern reflects its nature in some sense. The essence of modeling consists in simulating characteristics (structure, properties or interrelations) of a certain object in another one, specially designed for the study.

In modeling the professional competences development process we will rely upon generalized logic of educational study, this logic being, as Krayevsky, V.V., has reasonably mentioned, "a sequence of transitions from empiric description of the educational reality to its reflection in theoretic patterns and the normative form" (Krayevsky, V., 2001). This approach represents modeling as a form of theoretic thinking, as a means of displaying practical activity and as a criterion of scientific knowledge validity. It was these reasons that we have taken into consideration in creation of an authors' pattern.

In our case an object of modeling was represented by the process of building a student's professional competence in an engineering establishment. We should acknowledge that this notion is of integrative nature. We have already specified that a competence is determined not by the amount of acquired knowledge, but by a system of tested methods of searching for lacking data on the basis of integration of that available (Shemet, O., 2010). Studying developmental potential of project-based method, Bobyleva, O.V., also highlights this aspect. The author reasonably notes that "the competence-based approach doesn't imply grasping separated knowledge and skills but mastering them as a whole" (Bobyleva, O., 2014, p. 1). That is, the competence is a capability to integrate knowledge referring to different fields in order to work out an action required at the moment. As Serikov, V.V., has indicated, it is possible only in case of "insight into an integral situation in the course of activity" (Serikov, V., 1999). Therefore, the key criterion determining whether the competence is built, is student's capability to integrate in order to generate his own problem solving system.

2. Method

The process of competences building fundamentally differs from the process of acquiring conventional knowledge and skills. Competences can't be built only through skills (Shemet, O., Raymark, P., Schmit, M., & Guion, R., 1997). Improvement or polishing of skills lead only to increase of their amount, but don't contribute to competence building. The issue is about the nature of these notions. Skills are results of empiric thought which is commonly known to register extrinsic properties and relations of objects. This doesn't allow reading the object of the study in the context of its various internal interrelations. While it is known that the competence is expected to provide "insight into an integral situation in the course of activity", i.e. to have competence means to possess something *integral* permitting to work with its parts. This requires insight into current situation as some integrity having a considered object or a social, natural or technical phenomenon as a basis. "To gain insight means to express in terms of concepts" (Davydov, V., 2000, p. 307). This saying is also valid if formulated vice versa: to express an object or a phenomenon in terms of concepts means to gain *insight* into it. Hereinafter a *theoretic notion* is considered. It creates a mental image of the considered object or a phenomenon and indicates the essence of it. On this basis we suppose that it is knowing a theoretic notion, mental grasp

of the situation, or certain phenomenon of the objective reality as "a single source of certain variety of phenomena", or as "an integral situation in the course of activity", that finally permits to act in the context of a situation of uncertainty. In other words, the nature of an object or a phenomenon expressed in the form of a theoretic notion is the gnoseological foundation of competence. It allows a specialist to act in a professional and successful way under the new conditions.

The notion determines a *method*. Ability to formulate theoretic notions and use them as sophisticated categorical systems allows student's mind to attain such a level as to gain conceptual and diversified insight into an object and permits to completely master methods of the mode of actions required at present; this provides conditions for professional competences building. It can be said that the professional competence is a general form of reflecting a theoretic notion in the real life.

The nature of a *theoretic notion* is such as to serve both as a form of physical reflection of an object or a phenomenon and as a way, or means of their mental image; i.e. theoretic notions serve as special mental activity, thus, developing fundamentals of theoretic thought in students. In this case the change of educational emphasis is observed: it is not so important to acquire some established knowledge, as to make one's own efforts, display one's own initiative and personal meaning of the activity. According to Davydov, V.V. (Davydov, V., 2000; Davydov, V., 1996), theoretic thought is an ability to think by notions reflecting physical objects in the course of their change and development which took place within the wider integrity of things. «Theoretic thought is based on theoretic (or content-based) generalization. Analyzing a certain developing system of objects, one can find out its genetic source, relevant or global stance. To emphasize and grasp this stance means to generalize this system on the basis of its content. On the basis of this generalization, one can then trace the origin of particular and isolated features of the system to its genetic source and global stance. Theoretic thought is to make content-based generalization of this or that system and to reproduce it in one's mind, discovering its potential relevant and global stance…" (Davydov, V., 2000, p. 236).

In higher education established formulas and notions heard from other people are not at all sufficient; one should see and feel the range of problems underlying scientific theories which seem to be the most solid and indisputable (Zhurakovsky, V., 2010; Competences-based Approach in Higher Professional Education, 2008). Only in this case a prospective specialist will elaborate his own approach and his manner of actions and therefore acquire the experience of personal fulfillment in the context of the relevant task he carries out; this at large encourage competence building as the result of personal self-improvement. With this regard we believe that competence can be built through understanding theoretic notions. They underlie competence. In other words, training should result in formulation of a theoretic notion which determines the ability to solve this type of tasks referring to implementation of competence being built. That's why within educational environment competence building means formulation of a theoretic notion (or notions) of the considered object. It is generated through interdisciplinary synthesis and integration of theory and practice. Content of interdisciplinary relations is just aimed at formulation of theoretic notions. That is, educational material is acquired not only at the level of objective notions which are as a rule of empiric nature, but primarily through the forms of theoretic thought, at the level of definitions and personal meanings. "A theoretic notion serves as a certain and definite way of connecting the integral and the isolated, as a way to derive special and isolated phenomena from their integral basis" (Davydov, V., 2000, p. 362).

As Rosenthal, M.M., has reasonably noted, "… notions are tools of cognition of *changing* reality" (Davydov, V., 2000, p. 362). That is, competence building implies that theoretical notions referring to fulfillment of a certain type of professional activity should be formulated. These notions determine the ability to implement the competence built in the course of solving the relevant professional tasks. The notion initiates integration process, it accumulates diversified knowledge in the context of their new interpretation. In the course of their formulation the true integration is observed, since knowledge are not overlapped, not just accumulated, but are transformed and create the foundation for new psychological formations in one's mind.

Davydov, V.V., has proved that a theoretic notion is a means of mental reproduction of the nature of an object, an item or a phenomenon. It is this fact that allows a competent person to act efficiently even in case he has no certain skills. In other words, reproduction of the nature of an object, an item or a phenomenon displayed in terms of theoretic notions determines the engineer's ability to elaborate a mode of action required at the moment. This again proves our assertion that it is the mental ability of a prospective specialist to formulate and use theoretic notions that predetermines professional competence building. This affords ground for considering a theoretic notion as the cognitive basis for competences.

3. Results

3.1 The Theoretic Notion of the Competence Cognitive Basis.

Theoretic notions are the results of developmental teaching which starts from accumulation of some mental subtext in student's mind. A mental subtext is knowledge enclosed in the mind of a person being taught. He works closely with it. Translation of this knowledge into another teaching language results in a conditionally new knowledge in the person's mind. "…Conventionally appropriate translation is the principle of developmental teaching which at the same time is the method of fulfilling intellectual activity" (Danilyuk, A., 2000, p. 322). The person being taught is active with regard to his consciousness. In the course of teaching new mental subtexts are generated, new knowledge is acquired, new languages (semiotic systems) are learnt. When mental subtexts are divided, knowledge is arranged into notions, personal and cultural meanings, thus consciousness and professional thinking are developed.

In the course of educational activity in the framework of developmental teaching knowledge structurally transforms, is included into new psychological formations and converts into a system element of one's mind. "One of the key learning features of developmental teaching is that the crucial problem is that of knowledge and mind, knowledge arrangement in one's mind, while in reproduction education the objective is considered to be attained as soon as knowledge is acquired by one's mind" (Danilyuk, A., 2000, p. 353). Due to the nature of competence as the result of education competence doesn't directly result from education, but from development and self-development of a person, not from his engineering, but personal experience. The specifics of competences-based engineering education causes the teaching technique to be changed. This technique should imply "monitoring over the conditions of origin" of knowledge instead of acquisition of "established" knowledge selected and offered by teachers. It is expected that a student should be able to generate notions required for task fulfillment.

We have taken the above stated considerations as a basis of a theoretic pattern of professional competence building. The integrative nature of competences determines the fact that this pattern can be shown with the perspective of integration. That is why we have chosen a general pattern of education integration worked out by Danilyuk, A.Y., and introduced in his "Theory of Education Integration" to be its basis. The author studies education with the perspective of semiotics and uses a general theoretic pattern of "a thinking object" by Lotman, Y.M., as an ideal integration object (Lotman, Y., 1992).

It is fully justified, since education is actually the semiotic environment, it is possible to use semiotic methods in theory of education. Danilyuk, A.Y., has constructively introduced the pattern of "a thinking object" into secondary education (within the framework of the humanities) and described it in scientific terms of the education science. however we will try to extrapolate knowledge obtained by him to engineering education, since its integrative facilities allow for significant expansion of the field of application of this pattern. For this purpose a sequence of patterns should be built. In a successive order the following patterns will be described:
- A pattern of "a thinking object" (Lotman, Y.);
- A pattern of education integration (Danilyuk, A.);
- A pattern of professional competences building (the authors' pattern).

3.2 The Pattern of the thinking process by Lotman Y.

A theoretic pattern of the culture created by Lotman, Y., shows a formula of the thinking process. According to the author's concept "a thinking object as it is, can: 1) store and convey information (he has communication and memory mechanisms), command a language and can generate proper messages; 2) perform algorithm functions in order to transform these messages properly; 3) generate new messages" (Lotman, Y., 1992, p. 34). The latter feature is crucial for a thinking object, since intellectual behavior implies the ability of the object "to generate new messages" (texts). Figure 1 demonstrates a scheme of the Lotman's pattern.
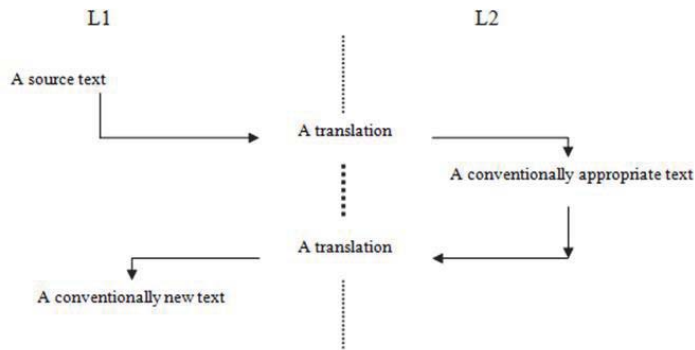
Figure 1 – The pattern of "a thinking object" by Lotman, Y.

According to the pattern considered the thinking process is effected within the system which implies at least double coding: initially information is arranged in a text according to one set of rules, then it is again coded and is presented as another, new text. The author considers that the basis of creative intellectual process in the course of which new texts are created is *conventionally appropriate translation.* This implies that "no thinking object can't be monolingual. The indispensable feature of any intellectual structure is its *internal semiotic heterogeneity*" (Lotman, Y., 1992, p. 35). The principle of semiotic heterogeneity is expressed though the fact that in educational process a certain semiotic system always has an opposite semiotic system with fundamentally different language arrangement. This fundamental principle of thinking and education allows generating new texts and acquiring knowledge.

Within the framework of his pattern Lotman, Y., interprets this principle as follows. "Let us imagine two languages, L1 and L2, which are organized in a fundamentally different ways, so that accurate translation from one language into another is quite impossible. We assume that one of them will be the language with discrete semiotic units having fixed meaning and linear sequence of syntagmatic text arrangement, the other one will be characterized by non-discreteness and spatial (continual) units arrangement. Thus, content planes of these languages will also fundamentally differ. In case we have to render a text in language L1 by means of language L2, no accurate translation is possible. At the best a text will be generated which in certain cultural context can be considered to be equivalent to the source … If later reverse translation into L1 will be performed, it is obvious that the source text will not be created. With respect to the source the created text will be a new message. Structure of conventionally appropriate translations can serve as one of simplified patterns of creative intellectual process. From what we have said follows that no thinking object can be monostructured and monolingual: it should always comprise multilingual and mutually unrenderable semiotic formations. Internal semiotic heterogeneity is the indispensable feature of any intellectual structure" (Lotman, Y., 1992, p. 35-36). Thus, it is obvious that information is re-encoded if it subsequently passes through systems of fundamentally different languages: initially information is presented in one language, then it is translated into another; in fact, this results in creation of a new text.

Danilyuk, A.Y., has used this pattern in his study of integration processes in education. "Following the principle of semiotic heterogeneity a "thinking object" combines and integrates various semiotic systems within itself. Combination of semiotic systems (texts) doesn't result in their mutual dissipation. The object thinks only when his integral semiotic systems preserve all their structural and language individuality and maintain their mutual semiotic opposition. Thus, educational thinking initially has the opportunity to see a phenomenon of education integration in the context of dialectic of two opposite and inseparably associated notions: integration and differentiation" (Danilyuk, A., 2000, p.175-176).

Due to the fact that education has been considered semiotically, from the point of view specified by Lotman's methodological provisions, the scholar has the reason to use the opportunities provided by the general theoretic pattern of a "thinking object" in creation of the ideal object of education integration. Danilyuk, A.Y., has constructively introduced this general theoretic pattern into the education science. This resulted in generation of the theoretic pattern of integration processes in education (a text-subject pattern) shown on Figure 2.

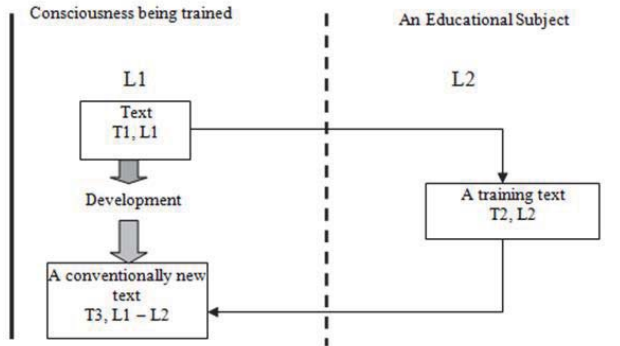### 3.3   The Pattern of Education Integration by Danilyuk, A.Y. (468)

Figure 2 – The Text-Subject Pattern of Educational Process by Danilyuk, A.Y.

The point of this pattern is that education integration represents the process of knowledge and consciousness association in the course of which quantitive and qualitative development of student's consciousness is observed. According to this pattern arrangement of the educational system is at large determined by semiotic opposition, i.e. the educational system comprises various training texts opposing student's consciousness with regard to the way of language arrangement and integration mechanisms which provide messages exchange between student's consciousness and the training texts.

It is known that the educational system can function in one of the three modes: information, knowledge-reproduction and personally developmental. Within this pattern translation of a certain mental subtext (knowledge within consciousness) into another training language is the main mechanism of developmental teaching. In this sense training activity is a "didactically organized act of semiotic transformation of a mental subtext". Thus, within the framework of the developmental teaching system a student works particularly with his own knowledge. Within this pattern a notion of education integration is interpreted as the simplest intellectual act (conventionally appropriate translation) underlying various educational forms and methods. Within the pattern of education integration the principle of semiotic heterogeneity is a provision for arrangement of the educational process.

The following definition shows the meaning of the pattern being studied. "Education integration is a process when a student guided by a teacher carries out consecutive translation of messages from one training language into another; in the course of this process knowledge is acquired, notions are formulated and personal and cultural meanings are generated" (Competences-based Approach, p. 232). The author interprets the notion of education integration as the simplest intellectual act (conventionally appropriate translation) underlying various educational forms and methods at large. The meaning of this process is discovered among its results which permit to pass an unbiased judgment of the processing history and to adjust the further process.

Within the framework of this pattern such means are represented by theoretic notions and personal and cultural meanings generated on the basis of these notions. It is obvious that this pattern can't be extrapolated to engineering education in its pure form. In the context of engineering education the pattern acquires another meaning and accumulates new elements. The matter consists in the following. A notion is theoretic abstraction. It allows describing an object or a phenomenon. While competence implies practical implementation of an object which is impossible without a "provisional basis of activity" (Serikov, V.V.), relying on an image of a product created and the logic of its creation. This can be reproduced only by acquisition of the mode of action (according to Galperin, P.Y.) which is the result of experience (Galperin, P., 1957). Thus, a theoretic notion is the obligatory, but insufficient provision for competence building. However, it is a theoretic notion that predetermines competence as it is.

In creation of the theoretic pattern of professional competence building we also have taken as a basis the principle of semiotic opposition as one the key principles of thinking and education. We believe that in an engineering establishment arrangement of the educational process according to the pattern of highly intellectual activity should also be of the bipolar nature, i.e. within its framework domains with fundamentally different language structure should be integrated.

Semiotic opposition is created within semiotic environment. In a higher education establishment it is possible to

arrange a broad range of such environments where information can be re-encoded in the course of its consecutive passing through systems with different languages. This will result in the following: integration of content of different disciplines; theory and practice integration; integration of different types of activity; integration of training content and personal experience.

3.4   The Pattern of Professional Competence Building in Engineering Education.

Semiotic opposition permits to understand the general character of spatial arrangement of competences-based engineering education. It is necessary for conventionally appropriate translation, i.e. translation of the same message (concept, knowledge, an empiric notion) from one language into another to get conventionally new texts (knowledge, meanings, personal meaning and theoretic notions), to be performed. So, conventionally appropriate translation is a educationally arranged process of consistent translation by student's consciousness of educational information about certain phenomenon into languages of various sciences and practice, i.e. the process of re-encoding knowledge by means of different semiotic systems (languages). This translation results in conventionally new knowledge. It is not imported from outside and is not "ready-to-use", but a student himself adds on it (with respect to the source knowledge) with the support of a teacher.

The increase of amount of conventionally new knowledge and their arrangement in a certain system with regard to an object of the study lead to fundamental changes in professional consciousness. In the course of this type of educational activity a student not only adds on the source knowledge, but also improves his thinking, world view and his own personality. Taking into account the above said we consider conventionally appropriate translation as they key teaching mechanism of developmental teaching within the framework of competences-based engineering education. It is a means of building professional competences. It provides clear understanding of the subject of educational activity and its interlocutory nature.

The interlocutory nature is represented by messages exchange, inclusion of texts of one subject domain into semiotic domain of another which provides intensified generation of new texts. Within our pattern we rely on the provision that semiotic opposition offers conditions for students' thinking intensification. The more opposing semiotic pairs are included in the process, the more conventionally appropriate translations will be generated. The theoretic pattern of professional competences building is shown on Figure 3.

In engineering education a lot of opposing semiotic pair can be generated; among them can be the following: content of different disciplines (content of the competence being built is studied within the framework of many disciplines and the more disciplines are included, the fuller will be its essence revealed), theory and practice, action and reflection, a training pattern and its verbal description and etc.. The essence of the offered pattern is as follows. Professional competence of a prospective engineer can be built by means of a sequence of conventionally appropriate translations performed by a student with the support of teachers; in the course of these translations knowledge is acquired, theoretic notions are formulated, personal meanings are developed, an idea of a provisional basis of activity is generated, an individual approach is elaborated and experience of self-fulfillment in competences-relevant and prospective activity is gained.

Within the framework of this pattern educational activity is arranged according to the rule of conventionally appropriate translation: training is performed through a sequence of conventionally appropriate translations which always start from the domain of consciousness being trained. It is the sequence of translations of this kind that provides strong competences to be built. Competence is the result of developmental teaching, that is why it is built within the domain of theoretic notions.

A competent action can't be built up until a theoretic notion of the activity subject and possible ways of its transformation are not generated. It serves as a theoretic basis of the action, since it provides understanding of why one should act in this way and not otherwise. It is what Serikov, V.V., describes as a "provisional basis of activity". Internal motivation determined by personal meaning offers focus on elaboration of an individual manner of action and an individual method of solving problems, thus, promoting the experience of performing this activity in problematic situations to be gained. Professional competence is interpretation of a theoretic notion by means of personal meaning and experience of personal development in professional activity. It represents the level of development of student's professional theoretic thinking and shows his personal and professional culture.
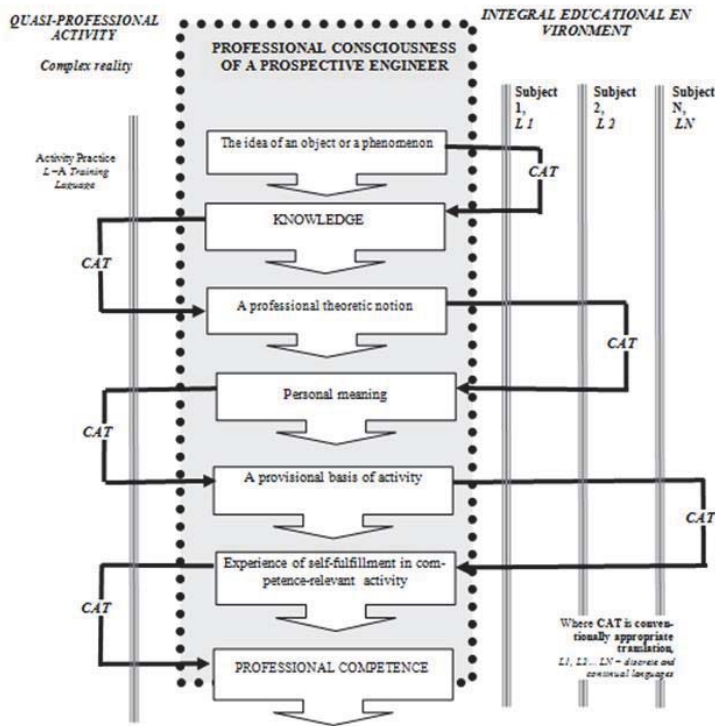
Figure 3 – The Theoretical Pattern of Professional Competences Building.

4. Discussion

A theoretic notion is a special new cognitive formation within student's consciousness. The specifics of its formulation is that information in the form of notions can be acquired only if it is simultaneously represented in different semiotic systems: of a word, image, action, theory and practice.

Notions can't be ultimately grasped, if training is performed on the basis of one language. This predetermines the fact that within the framework both of our pattern and of the pattern of Danilyuk, A.Y., the principle of semiotic heterogeneity is a provision for arrangement of the educational process. The author of the theory of education integration formulates this principle as follows. "The educational system consists of consciousness being trained, training texts semiotically opposing each other and integration mechanisms providing consecutive translation of messages from the student's language into languages of training texts and vice versa" (Danilyuk, A., 2000, p. 244). On the basis of this principle a method of competences-based engineering education which conceptually is its key training mechanism, can be defined as conventionally appropriate translation.

Each conventionally based translation causes new mental subtexts in student's conscious; being accumulated, these subtexts expand their semantic and language range and fundamentally change.

The conducted study has permitted to find out and lay down a range of principles determining the process of professional competences building.

1. The process of professional competences building is of integrative nature.
2. Professional competence is built by means of conventionally appropriate translation (re-encoding) certain information from the language of one educational subject into languages of other educational subjects and practice.
3. Professional competence is built within the framework of a semiotically heterogeneous educational system. The extent to which professional competence is built is in direct proportion to the amount of semiotic oppositions involved in the educational process.

5. Conclusion

The stated principles suggest the following conclusions. No competence can be built within the framework of one discipline. The teaching provision for its building is a sequence of conventionally appropriate translations performed. For this purpose it is necessary to include as many semiotically heterogeneous environments with different languages as possible. However the process of competence building can't be considered as mindless addition of new elements (texts) which are accumulated in student's consciousness. By adding a new component the whole structure of consciousness is transformed, it acquires new properties and a new type of integration. This allows talking about generation of new psychological formations (certain new structures defining another way of reflecting the objective reality in one's consciousness) in student's consciousness.

The suggested pattern fundamentally change the view on content and arrangement of competences-based education. Taking into account that the extent to which professional competence is built is in direct proportion to the amount of semiotic oppositions involved in the educational process, its practical implementation provides development of such training modules which can integrate domains with fundamentally different language structures. Their bipolar nature provides conditions for re-encoding information in the course of its consecutive passing through the systems with different languages. Such arguments give reasons to believe that these training modules reproducing a certain integral fragment of natural, cultural, social or technical reality can serve as the key educational unit implementing certain competence building. Therefore, the pattern of professional competences building described in this article can provide structural modernization of engineering education.

The suggested approach to organization of engineering education serves as a basis for practical design of informative and procedural elements of competence-based education and design of professional training and education technologies. The developed technological complex of organizational and educational conditions (a model of professional competence building, a mechanism of developmental education adjusted for higher professional education, objective laws determining the process of professional competences building and etc.) enables to use more fully the constructive capabilities of the competence-based approach in engineering education.

The developed theoretical model of professional competence building allows handling a range of important applied problems of the educational process: designing principal educational programs, operating programs of modules, educational subjects and practical trainings and working out diagnostic tools for competence-based engineering education.

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