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DIAGNOSTICS OF COMPETITIVE ABILITIES AMONG STUDENTS SPECIALIZED IN SOFTWARE ENGINEERING AT A TECHNICAL UNIVERSITY

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Abstract.

According to determined features and levels of competitive abilities among students specialized in software engineering a diagnostic card for quality genesis has been developed and a diagnostic toolset has been selected.

Keywords: competitive abilities of software engineers, diagnostics of competitive abilities, diagnostic card.

The ability to make a decision without assistance, to adapt quickly to a new task, a wide range of interests in the specialized subject must become basic professional qualities of future software engineers. According to some experts and employers, the quality of software engineers' professional training far not fully meets present-day requirements. "The staff shortage has been increasing in IT-companies, but higher education institutions train specialists for solving yesterday's tasks... curriculum orientation, inadequacy of graduates to the requirements of the market don't allow domestic companies to develop in a full rate" [10]. Statistics data testify about insufficient mobility of graduates in software engineering in the

labour market and low rates of new technologies implementation, which indirectly testify about insufficient competitive strength of specialists in this field.

The problem of assessment of a future software engineer training helps clear up the idea of the professional selection role as an initial stage allowing to set the pace in the next stage of the professional training; the place of the professional competitiveness as a basic high quality parameter of competitiveness characteristics; the criteria and the nature of personal-professional and social competences of a specialists.

Professional problems, dynamism and relativity of a specialist's competitiveness define the assortment of a future software engineer's qualities, abilities and corresponding resources required to solve problems. The competitiveness of a specialist is defined by combination of his various abilities, the level of their development and the state of his resources to eliminate and solve problems better than other specialists in this field.

The formation of competitiveness as a quality of a specialist in the market economy conditions is an important task of the modern higher education which is considered in the works of S.Y. Batishev, A.P. Belyayev, V.M. Dyomin, G.I. Ibragimov, A.Y. Nain, Y.N. Petrov, P.N. Osipov, N.G. Yaroshenko and others.

There is a difficulty in understanding the nature, conditions and mechanisms of a specialist's quality development, the possibility of its preliminary diagnosis. As a methodological basis of solving these problems at present competence approach is considered as a principle of modeling in the content and technologies of training highly effective professional activity (V. A. Bolotov, V.V. Serikov, A.V. Khutorskoy, I. D. Frumin, B.D. Elkonin and others).

The conducted analysis of psychological and pedagogical research has shown that the problem being considered has never been the subject of scientific research with reference to software engineers before. Though, theoretical prerequisites to its solution have appeared in the works of S.I. Archangelsky, Y.K. Babansky, V.P. Bepalko, I.E. Vvedensky and others. Psychological mechanisms of professional and personal students' formation have been studied by: A.G. Asmolov, I.I. Ilyasov, E.A. Klimov, A.G. Kovalev, R.S. Nemova, R.M. Petruneva, N.V. Chigirinskaya, and others. In the research of A.M. Mitina the content and structure of competitiveness, its demonstration in the activity and communication of a person are offered. All these things have created the basis for the solution of the problem of a specialist's competitiveness development diagnosis.

As the result of the conducted research in this field and our own experience we have chosen the following features of a software engineer's competitiveness (in general):

1. Having key and basic competences in one's professional field:

- engineering thinking (professional mobility and will to develop oneself; being broad-minded; humanization (the ability to adapt any technical inventions and scientific discoveries to human aims without any harm towards the mankind and the nature));

- knowledge, abilities and skills in the professional field;

- communicative competence (being initiative and active; leadership; discussions and arguments).

2. Ability to orientate in the market conditions of one's professional area:

- informational competence (particular skills to use technical devices (from telephone to a personal computer and computer networks); ability to elicit information from different sources including electronic service lines, to present the information in a comprehensible way, to be able to structure, assess and use it effectively; to have the abilities for analytical processing and knowledge of the dataflow peculiarities in the professional field).

3. Psychological readiness to competitive behaviour (activity in the situations suggesting rivalry, competition, mobility, prediction of a rival's actions, ability to define priorities, professional intuition):

- need for successful activity (being initiative, being active and willing to be a leader; realizing one's aims in the activity; being able to organize oneself and other people for a successful activity);

- responsibility (having energy to complete the work; the speed of reaction for different situations; participation in the public affairs).

4. Starting capabilities (fundamental knowledge, practical experience, cultural potential, endowments):

- creative potential (quantity of ideas at a time; ability to produce "rare" ideas different from conventional, typical answers; sensitivity to unusual details, contradictions and uncertainty, readiness to switch over from one idea to another with flexibility and quickness; readiness to work in a fantastic, unbelievable context, tendency to use symbolic, associative means for expressing one's thoughts, and also ability to see the complicated in the simple and vice versa).

5. Ability in self-regulation, self-organization and adequate reflexion, self-rating of professional and personal qualities:

- engineering reflexion (to be willing to assess oneself and results of the work critically; to know the main point and the purpose of the engineering reflexion, to realize its importance for self-development; the ability to analyze one's activity, to assess one's professional capabilities, to predict one's development);

- self-sufficiency (an interest and persistence in solving engineering tasks (problems); knowledge about the process and efficient ways of solving

engineering tasks (problems); ability to solve formulated tasks (problems) in various ways).

6. Social and legal competence:

- legal competence (an interest and persistence in knowing one's rights; knowing the ways of solving legal problems; ability to solve them).

The analysis of research dealing with professional effectiveness of software engineers allowed to define structural components of competitiveness, such as:

1. *Cognitive competences* observed in readiness of a software engineer to create programs (on the basis of analysis of mathematical models and algorithms of solving tasks) providing implementation of the algorithm and the task formulated by means of a computer, to conduct its testing and debugging, to choose a programming language, program updating on the basis of output data analysis; to elaborate instructions how to use programs, necessary technical documentation, systems of automatic program testing.

2. *Informational competence* suggesting skills of a personal computer and computer networks user; the ability to elicit information from different sources including electronic service lines, to be able to structure, assess and use information effectively.

3. *Engineering thinking* shown as an ability to raise and solve problems providing submission of technical projects and inventions to the aims of human beings, without any harm towards the mankind and the nature.

4. *Self-sufficiency* realized when choosing effective ways of solving engineering tasks and *responsibility* in making social engineering decisions.

5. *Reflexion* in the form of critical self-rating and assessment of results of one's work, the ability to analyze one's activity, to assess one's professional capabilities and development potential.

6. *Need* for a successful activity: initiative, activity and will to be a leader, to be ahead of the rivals; realizing the aims and the main points of one's activity; being able to organize oneself and other people in order to success.

7. *Creative potential* shown as fluency, originality (the ability to produce "rare" ideas different from conventional, typical answers), receptivity (sensitivity to unusual details, contradictions and uncertainty, readiness to switch over from one idea to another with flexibility and quickness) and being metaphorical (readiness to work in a fantastic, unbelievable context, tendency to use symbolic, associative means for expressing one's thoughts, and also ability to see the complicated in the simple and vice versa).

8. *Legal competence* shown as the knowledge of management directives and normative documents regulating algorithms and program elaborating and the use of a computer when processing the data; fundamentals of labour legislation; rules and standards of labour protection; knowledge of the

ways of solving legal problems.

9. *Communicative competence*: being initiative and active in solving professional tasks; ability to conduct debates and arguments in the professional (formal) language.

According to the defined features of competitiveness in our research some levels of a software engineer competitiveness development have been found.

Low level: immobile; narrow-minded; lack of one's own ideas; slow to switch over to other kinds of the activity; difficult to adapt to unusual situations; minimum of informational and technological knowledge in the professional area; he/she doesn't understand the importance of self-education and self-development in the professional growth; passive; he/she doesn't know legal regulations essential to a successful professional activity; not sociable (he/she can't clearly define a technical task, has communication problems); does not always complete the work; can't overcome problematic and conflict situations; often needs help.

Medium level: mobile; broad-minded enough; he/she produces a number of ideas, but not always original ones; needs help in non-standard situations; realizes the importance of informational and technological knowledge and self-education for the professional growth; doesn't always overcome difficulties in professional and interpersonal communication; tendency to complete the work; active and initiative depending on the situation; he/she plays the part of "a situational leader"; knows one's rights, but doesn't always use them.

High level: mobile; he/she produces a great number of original ideas; creative in understanding and solving problematic situations; active and initiative without any outer stimulation, he offers various hypotheses about possibilities of application of the discovered way in other conditions or its improvement and tends to study validity of these hypotheses; high level of knowledge in his professional area; broad-minded; he/she needs to broaden the knowledge; knows and realizes the nature of public and legal phenomena and understands the necessity of the law as the regulator of public relations; plays the part of "a universal leader".

The features defined and the levels of a software engineer's competitiveness development allow to determine methods of studying the phenomenon of competitiveness: observation, testing, individual and group conversations with students and lecturers, studying syllabuses on special subjects. The methods determined, observing the students in different conditions of curriculum and extra-curriculum process, representative sampling provide an objective character of the data obtained.

The diagnostics is a process which allows (if following necessary scientific criteria) the teacher to observe the students and carry out surveys, to

process data on the observations and surveys and to report on the results obtained with the aim of describing one's behaviour, explaining its motives; it also helps to predict one's behavior in the future [3].

Diagnostic methods of quality evaluation are to be presented in two groups:

- evaluation of professional competitiveness on the basis of the qualification standard;
- evaluation of professional competitiveness of a software engineer as a personality.

On the basis of the features defined and the levels of competitiveness among students specialized in software engineering a diagnostic card has been developed which is presented in table 1.

As diagnostic objects knowledge and skills being the key professional competences have been determined; attitude to the profession, to the professional values, professional motivation, interests, professional qualities.

In order to define the level of competitiveness development among students specialized in software engineering on the basis of the diagnostic card we used a complex of diagnostic methods which consists of two groups.

The first group was supposed to elicit the development of professional and personal competences: engineering thinking (test on mathematics [5], Bennet test (assessment of the level of technical thinking development) [6], one's informational culture [2], knowledge, skills and abilities (students' rating); self-sufficiency [7], responsibility [8], need for a successful activity [7, 8], engineering reflexion [5], levels of personal creative potential [1].

The second group was supposed to reveal such social competences as the legal one (through conversations and surveys) and the communicative one [8].

In order to define engineering reflexion the ranking method of self-evaluation studying was taken as the basis [8]. The qualities taken into consideration were those of developing competitiveness among students specialized in software engineering. When choosing those qualities we considered the definition of a software engineer taken from the dictionary of professions [4].

The system of diagnostic methods of professional knowledge, skills and abilities assessment presented in the following logic contributes to:

- overcoming the contradiction between the necessity for continuous improvement of education quality assessment methods and pedagogical requirements to their stability;
- increasing the training quality of students specialized in software engineering, which is highly demanded at present for them to be liberal, self-sufficient in choosing the behaviour and the sphere of actions, with high level of

adaptability and survival in the context of professional appropriateness changes.

The specific character of the diagnostic card is supposed to be the anticipating diagnostics of a software engineer competitiveness qualities which can be demonstrated at the professional stage of a specialist's development. The diagnostics able to anticipate the competitive potential of a future specialist is meant. Moreover, "the launch" of the diagnostic card is considered as "a mechanism" of adequate self-evaluation development in the process of competitive software engineer training.

When monitoring the diagnostic card is supposed to be the tool of monitoring the genesis of this quality and foreseeing competitive qualities of a specialist in the future, revealing and overcoming stagnations in development of software engineers' competitiveness, realizing the individual approach to a student's competitiveness development with the levels competitiveness taken into account.

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