MODERN APPROACHES TO ENGINEERING EDUCATION

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The authors of this paper explore alterations in subject – object relations between a teacher and a student in new educational paradigm when students direct their own learning-cognitive activity. When implementing new pedagogical technologies such as distance-learning, e-learning and m-learning, one of the major problems for teachers is to create educational environment that allows students to direct their own learning-cognitive activity. Different information barriers impede travel of information flows and their perception. These barriers reduce potential value of learning material. In new educational technologies (distance-learning, e-learning and m-learning) students receive strong psychological support through their communicative activity. New educational environment brings about new learning situations and relations.

Pedagogy, as the science of education, learning and human development, originates from the ideas of Demokrit (460–370 BC), Socrates (469–399 BC), Platon (427–347 BC) and Aristotle (384–322 BC). Erasmus Roterodamus (1465–1536) is considered the first teacher and John Amos Comenius (1592–1670) is the first didact.

Until recently classical pedagogy has dominated in education. Classical pedagogy based on didactic of John Comenius when a teacher being bearer of great volume of systemized information conveys this information to a student and the student has to master this considerable volume of knowledge.

Rapid development of the Internet and multimedia has given a strong incentive to the appearance of new pedagogy and new pedagogic technologies. The use of internet and multimedia technologies in education is becoming more and more popular among the majority of population. The advantages of computer – or web-based education over traditional classroom education include the ability to: study while at work, remain in one location with no need to travel; plan own training, attend courses across physical, political, and economic boundaries. In turn, higher education institutions obtain modern educational tools at their disposal. Distance-learning, e-learning and m-learning provide individualized learning, individual oriented approach and humanization of learning.

This paper presents three important aspects of a modern educational paradigm. It describes new subject-object relations established among students and teachers who are involved in learning process on condition that of self-directed, individual-oriented and student-centered teaching methods are used; analyses issues of pedagogic value and utility of electronic educational environment; addresses issues of information interaction among students and teachers in new educational environment.

Educational need includes two components: need to receive information and need to learn the surrounding world, which are not one and the same. Satisfaction of information need relates to obtaining and use of information, but satisfaction of cognitive need relates to obtaining and use of knowledge. Analysis of the information – knowledge correlation allows one to understand that information activity of the individual relates to his/her perception and use of this information in the process of communication, while cognitive activity means creative activity, which is aimed at obtaining of new knowledge. The formation of the subject's or the student's thesaurus results from the activity which aim is to meet information and cognitive needs. The individual, who is in conscious action of cognitive activity, has to direct his/her learning cognitive activity.

Student's self-direction of learning cognitive activity has become important since internet-education, distance-learning, e-learning and m-learning emerged. In these models of education the student is to become a true subject of learning activity and at the same time the student is to remain the object of the teacher's control. The student, as the subject, should form his/her learning cognitive activity, but this activity is to be realized in the frame of the model developed by the teacher.

The goal of Self-Directed Learning (SDL) is to develop the student personality when he/she masters knowledge in the concrete subject field. Personal development means step-by-step action from learning under the teacher's control to self-directed learning and from SDL to self-learning. As a result abilities for self-education, self-discipline and self-developments are formed. The essence of SDL is that the teacher should direct the process of student's self-learning activity formation (Ellis H.J.C., 2007; Splitt F.G., 2003; Krouk B., Zhuravleva O. 2009; Kruk B., Zhuravleva O., 2010).

The term «interaction» implies counter activity: actions like «object-subject». The moment of interaction happens when the subject, who conveys information, receives informa-

tion about the object's state via feedback channels and, what is most important, the subject learns of the changes, which occur in the object in the result of interaction. Feedback allows the teacher to bring about improvements into methods and means of teaching.

Learning and education mean control of human consciousness. Mechanism of learning and education is subject-object relations in info-interaction. Objective of learning and education is to teach an individual to solve nonstandard problems, which require unconventional methods of approaching and this, in turn, supposes high level of intelligence and abilities to think independently. The main objective of any learning is to form student's intelligence and prepare the student to a certain intellectual (professional) activity. Intelligence cannot develop out of info-interaction. The analysis of subject-object relations show that this activity is based on the following circumstances. Cognition process occurs due to specific mechanism which is termed information interaction. Info-interaction is founded on subject-object relations established between the subject (teacher) and the object (student). Object's activity depends on subject's activity: the teacher may suppress student's cognitive interest or on the contrary, develop student's interest to the level when high intellectual abilities are formed. If there is a feedback channel from object to subject, it allows the subject to improve the object's learning-cognitive activity and create conditions for SDL.

When the conditions needed for SDL created, the most essential thing for the object is ability for self-direction, self-control, self-education and self-development. In this case, the student is transformed into a true subject of learning-cognitive activity; furthermore activity of the student's information interaction is considerably increasing. Only an active person proving to be an individual in learning and influencing on the whole learning process and on progress in learning may act as the subject of learning-cognitive activity.

One of the major problems for teachers is to create an educational environment that allows students to direct their own learning-cognitive activity (Garofalakis et.al., 2002; Gick, Holyoak, 1987; Glaserfeld, 1989). Self-directed learning assumed particular importance at the time when on-line learning made its appearance (Evans and Sabry, *2003*; Dearholf et al., 2004). According to the theory of self-directed learning, the student builds his/her own learning and cognitive activity within the framework of the model developed by the instructor (Petridis et al. 2003).

In e-learning information-educational environment acts as a tool of subject-object information interaction meant to form student's fund of knowledge – thesaurus, which is enriched during the life and is a basis of any kind of activity. An individual's ability to use accumulated knowledge in order to achieve a certain objective testifies to his/her intelligence. The student's information interaction with training material underlies formation of intelligence and knowledge, i.e. the student's thesaurus. Therefore it is very important to investigate axiological characteristics of e-learning environment.

In traditional interpretation the value means ability of an object and a thing to satisfy some requirements of an individual. The more the individual is satisfied, the higher the value is. Similar to this, the characteristic of information-educational environment allowing students to use this environment to achieve set objectives act as pedagogical value. It should be noticed that one and the same information-educational block can have different pedagogical value from the point of its use for various learning objectives.

Another axiological category, namely, pedagogical utility of teaching material is closely associated with the category of pedagogical value. Pedagogical value is a more general characteristic than pedagogical utility. There are two categories of value: potential and actual. It is possible to notice that pedagogical utility is a actual pedagogical value. In other words, the information, which is useful to achieve a learning outcome, is of actual value.

It is necessary to understand clearly that the degree of actualization of pedagogical value depends on a number of factors and personal characteristics of the student, i.e. the object of information interaction. The larger fund of knowledge and the more complex thesaurus the student possesses, the more successfully the student applies the information received in order to achieve a learning objective or, in other words, the more useful this information is for the student.

The pedagogic value of information-educational environment is not an invariant axiological category. Horizontal and vertical alterations are typical of information-educational environment. Horizontal alterations mean that pedagogic value of information-educational environment is acknowledged not only by individuals or small social groups, who benefit a lot from the teaching material, but by the general pedagogic public and many students. Vertical alterations of this category lead to increase or decrease of pedagogic value of information materials. Upward motion has a subjunctive meaning and relates to the information updating by the doer and downward motion has an imperative meaning and relates to the process

when the information becomes outdated and where the most destructive factor is time. In the system of distance learning and e-learning pedagogic value of teaching material is influenced by the character and means of subject-object information interaction. First of all, it is interaction among the teacher (tutor) and the student, between separate students and student groups. It is also interaction with e-teaching material. For this, e-teaching material should be «tuned» to a uninterrupted «dialogue» with the student. The more opportunities the student has to direct his/her process of cognition by interactive means, the higher the actualization degree of pedagogical value of teaching material is. In other words, pedagogical value of teaching material is becoming high. There are two types of interaction. They are direct interaction on the object of learning process when the teacher conveys information to the student, and indirect interaction when information is conveyed and apprehended without the teacher. In any type of interaction the main factor is to establish feedback. Feedback allows revealing the student's reaction to provided information and to use it in order to improve learning process. Availability of feedback makes the process of information interaction among the subject and the object synchronous. The delay in feedback results in asynchronous interaction. The examples of synchronous direct interaction are participation in chats, videoconferences and the examples of synchronous indirect interaction are instant evaluation of students' answers to the tests by teaching machines and instant reactions of teaching simulators to the alterations entered by students. Asynchronous information interaction occurs, for example, in the form of participation in Web-forums, disputes in discussion rooms. Whatever high pedagogical value the e-textbook has been provided with, the most important factor in distance learning is to transfer information. When the information flow is reduced during transmission, information interaction can be diminished, therefore, pedagogical value of teaching material can be decreased.

Various information barriers or info-barriers impede travel and perception of information flows. In information theory this term is used to denote the range of objective and subjective factors, which influence on the process of information transferring to the object of interaction. It is clear that info-barriers diminish potential value of teaching material. A short description of some info-barriers is cited below.

One can speak of geographical and technical info-barriers, which lead to weak interaction and hence decrease of teaching materials' value because of remote location of towns and lack of proper facilities. Thesaurus info-barrier has

been also mentioned, when available fund of knowledge is not enough to understand teaching material. Terminological (language) barrier takes place, if the terms used in the textbook are not clear and unknown for the information user. Some of psychological and communication info-barriers are associated with mistrust to new methods and technologies of training, and with special perception of nonverbal methods of training. There is a whole range of situational info-barriers, which happen in concrete situations, for example, when the amount of information does not correspond to the time that the object of information interaction has. There is a considerable amount of other information barriers that occur while learning in electronic environment. The objective of info-barriers analysis and search of ways how to overcome or eliminate them is very important because it is related to the increase of pedagogical value of electronic educational environment.

In e-learning, distance learning and m-learning students received psychological support from their communication activity. Being isolated from the educational institution and lacking constant communication with teachers and students, the student may experience psychological discomfort, and suffer from isolation and neglect in comparison with other students. Therefore, for these types of learning it is very important to set up constant contacts of students with the administration of the educational institution, teachers and colleagues, who are geographically isolated. Such communication contacts allow teachers to answer students' questions promptly, to identify difficulties that students face with, and render them assistance by making an impression of constant communication among individuals and geographically isolated groups. For students these communication contacts enable to compare their progress in learning with the progress of other students and to render mutual assistance.

In human communication personality plays a very important role. For many students the personality of the teacher determines their attitude to the subject they learn. Participants of interpersonal communication influence on each other through facial expressions, gestures and voice timbres. Nonverbal communication increases the efficiency of communication process. When shifting to new types of learning, it is necessary to take measures compensating the lack of interpersonal communication. Educational process should be considered as interpersonal and dialogue interaction in «teacher-student» and «student-student» systems aimed at formation of theoretical and practical thinking and development of the personality of a future specialist. Dialogue lay the foundation of educational process by turning it into a mutual

cooperation favoring the mutual development of all participants involved in this process.

The lack of communication activity in learning may result in several problems: lack of interpersonal contacts among the participants of learning process; inability to create favorable psychological climate and comfort conditions for learning; lack of efficient control for students' mastering the content of learning, inability to organize students to work at teaching material in a team; inadequate perception and interpretation of teaching materials; interest decrease in learning up to a complete vanishing of motivation to learn through new technologies.

Via the Internet communication means various kinds of electronic communication can be organized. They are informing of students (bulletin board, student portfolio, visit cards); individual and group consultations for students (e-mail, mailing lists, news group, audio- and video conferences, forums, chats); electronic workshops (mailing lists, group news, chats, e-conferences, forums); teamwork in small groups (forums, whiteboard); student mutual help (e-mail, mailing lists, news group, conferences, forums, chats); monitoring of student's progress (e-mail, chats).

In order to organize efficient distance learning via the Internet one should take into account characteristics of telecommunication environment and human behavioral features in this environment. New communication environment creates new learning situations and new learning relations (Chou, 2003; Regueras et al., 2009).

The authors of this paper explore alterations in subject – object relations between a teacher and a student in new educational paradigm when students direct their own learning-cognitive activity (Kruk B. et al., 2010). Herewith the student is transformed from an object of the teacher's influence to a true subject of learning-cognitive activity. When implementing new pedagogical technologies such as distance-learning, e-learning and m-learning, one of the major problems for teachers is to create educational environment that allows students to direct their own learning-cognitive activity.

The network educational communication is effective as it is based on a subject-subject model, where mutual interaction of subjects takes part. The arrangement of effective education in new educational environment requires considering characteristics of this environment as well as behavior of a person in this environment. New educational environment brings about new learning situations and relations.

References

1. Chou C. (2003) Interactivity and Interactive Functions in Web-Based Learning Systems: A Teaching Framework for Designers // Br. J. Educ. Technol. – 2003. – Vol. 34, no. 3. – P. 265–279.

2. Dearholf D.W., Alf K.J., Halpin R.F., Oliver R.L. (2004). Foundational Aspects of Student-Controlled Learning: A Paradigm for Design, Development and Assessment Appropriate for Web-Based Instruction // J. Eng. Educ. – Apr. 2004. – Vol. 93, no. 2. – P. 129–138,

3. Ellis H.J.C. (2007). An Assessment of a Self-Directed Learning Approach in a Graduate Web Application Design and Development Course // IEEE Transactions on Education. – Feb. 2007. – vol. 50, no.1. – P. 55–60.

4. Evans C., Sabry K. (2003). Evaluation of the Interactivity of Web-Based Learning Systems: Principles and Process // J. Innovations Educ. Teaching Int. – 2003. – Vol. 40, no. 1. P. 89–99.

5. Garofalakis J., Sakkopoulos E., Sirmakessis S., Tsakalidis A. (2002). Integrating Adaptive Techniques into Virtual University Learning Environment // Proceedings of IEEE Int. Conf. Advanced Learning Technologies. – 2002. – P. 28–33.

6. Gick M.L., Holyoak K.J. (1987). The Cognitive Basis of Knowledge Transfer, Transfer of Learning: Contemporary Research and Applications, S.M. Cornier and J.D. Hagman, Eds. – New-York: Academic, 1987. – P. 9–46.

7. Krouk B., Zhuravleva O. (2009) Dynamic Training Elements in a Circuit Theory Course to Implement a Self-Directed Learning Process // IEEE Transactions on Education. – august 2009. – Vol. 52, no 3. – P. 394–399.

8. Kruk B., Sitnikov S., Zhuravleva O., Chupakhina N. (2010) Change of educational paradigm to respond the chellenge of information society // Proceedings of International Conference «PHOENIX – PHE», ICL2010. – 23–25 September 2010. – Brazov, Romania. – P. 175–182.

9. Kruk B., Zhuravleva O. (2010) Corporate E-Learning Strategy // International Journal of Advanced Corporate Learning (iJAC). 2010. – Vol.3, No.4. – P. 41–44.

10. Petridis V., Kazarlis S., Kaburlasos V.G. (2003). ACES: An Interactive Software Platform for Self-Instruction and Self-Evaluation in Automatic Control Systems // IEEE Trans. Educ. – Feb. 2003. – Vol. 46, no. 1. – P. 102–110.

11. Regueras L.M., Verdu E., Munoz M.F., Perez M.A., Castro J.P. (2009). Effects of Competitive E-Learning Tools on Higher Education Students // A Case Study, IEEE Trans. Educ. – May 2009. – Vol. 52, no.2. – P. 279–285.

12. Splitt F.G. (2003). The challenge to change: on realizing the new paradigm for engineering education // J. Eng. Educ. – April 2003. – vol. 92, no. 2. – P. 181–187.