



Problems related to the Formation of Cognitive and Communicative Competences in Engineering Students

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ABSTRACT This paper is dedicated to the analysis of problems related to the training of engineering specialists in Russia. Based on the application of active forms of psychological and pedagogical follow-up, the method of enhancing the quality of higher education has been thus proposed. Moreover, the method of psychological and pedagogical monitoring in the process of teaching engineering students has been suggested. The technique developed is aimed at forming and enhancing psychological follow-up of moral building and educational process. The application of the method favors the formation of cognitive and communicative competences of engineering students. A personalized approach with the application of the proposed method also facilitates the identification of students' potentials and control of their psychological states as well as their timely correction. For the useful application of the suggested method, it is necessary to enhance teachers' professional development in terms of their psychological training via engagement of professional psychologists.

INTRODUCTION

Quality development of a country, along with the satisfaction of the needs raised in each layer of its population, is, in many ways, defined by the quality and quantity of engineering innovations. A range of surveys and pieces of evidence, including ones received from the Ministry of Education and Science of the Russian Federation, prove demands for engineering specialties in the Russian market. According to the surveys, needs for engineers have grown by 19.6 percent during the last three years, and it also keeps growing (Ministry of Education and Science 2016). However, today, there is a critical lack of competent engineering staff in the industrial sector. The quality of engineering education in Russia has always been on a high level, and it is currently far from perfect - some young engineers lack even basic knowledge, which signifies a low level of professional preparation (Wickens et al. 2015; Card 2018).

The competence levels of engineers can be thus increased not only via direct educational technologies, but also by means of the introduction of specialized psychological and pedagogical follow-up in higher educational institutions that would be aimed at enhancing both

moral building and educational processes (Agranovich and Puente 2007).

During the last 10-15 years, the main direction of changes in the sphere of education of the Russian Federation has been directed at restructuring and management of educational contents. Accordingly, some critical problems related to the training of engineering staff today are:

- ◆ Low levels of student's motivation in receiving higher education;
- ◆ Insufficient quality of educational processes;
- ◆ Lack of informational and educational support;
- ◆ Tiredness and absentmindedness of both students and teachers;
- ◆ Outdated and irrelevant information received by students at various discipline courses.

One of the factors playing a crucial part in the development of a highly-skilled engineer is the quality of teaching and ability of teachers to effectively communicate information to students. Only involved students' development, comprised of universal, cultural, personal, and cognitive aspects, allows them to perceive information in full (McMichael 2013). In this respect, the critical educational results include

subject-related and personal competencies whose measurement requires the creation of a diagnostic system of the educational process and technologies of formation, and measurement of the mentioned competences becomes the main subject of activity of a psychologist (Gorodetskaya et al. 2015).

Thus, it is of importance to pay attention not only to physical but also to psychical health of students, which is the critical factor in the process of an engineer's establishment. More attention should be thus paid to the personalization of educational methods and the creation of a comfortable and psychologically safe educational environment (Yang 2019).

Objectives

In the current study, it was tried to analyze the problems which are related to the training of engineering specialists in Russia.

METHODOLOGY

In this work, the main ways of scientific thinking, such as analysis, synthesis, classification, and generalization, were used, which allowed for formulating the problem of the formation of cognitive and communicative competences in students and developing possible solutions.

Switching focus on psychological aspects of educational process significantly changes the entire educational situation in institutions; thus, defining the precise position of forms and types of applications of mental knowledge in content and organization of educational environment of higher and secondary educational institutions urges to make psychologists' activity obligatory, specific, and measurable; and accordingly psychologists themselves become full-fledged participants of educational process (Zotova 2014).

The aim of the supposed psychological follow-up is the creation of social and psychological conditions for the development of students' personalities and their successful training, as well as for laying the foundations of present and future mental health of a person. The main tasks of psychological and pedagogical follow-up are as follows:

- ◆ Monitoring the psychological and pedagogical status of students and the dynamics of their mental development in the process of education;
- ◆ Formation of self-cognition, self-development, and self-identification abilities.

The primary forms of psychological and pedagogical follow-up of the educational process, including consulting, diagnostics, as well as developing and correctional work and testing.

Consulting implies psychological help in the areas of development, mentoring, and education by means of psychological consultation. In this respect, psychological consultation helps students to correctly understand themselves, adequately assess their thoughts and deeds, know and take advantage of their strong and weak points, make right decisions, and bear responsibility for them, design and accomplish actions that allow managing their lives, and make it better effectively.

Methods of psychological consulting may include various training courses and discussion methods that allow for activating cognitive skills and enlarging possibilities of understanding.

RESULTS AND DISCUSSION

The aim of the diagnostics is to detect students' individual psychological peculiarities and to assess levels of their personal and intellectual development (Mongraphy et al. 2014; Sapegina 2016).

The psychological correction has a powerful influence on the process of personality formation and preservation of its individual characteristics, which is performed on the basis of mutual actions of pedagogues, psychologists, and specialists of other professions. The aim of correctional and development work is to organize the work with students that have some problems with learning and adaptation. The developmental work includes the development of students' cognitive sphere and its aspects such as attention, imagination, and memory. It also implies reducing anxiety and building adequate self-esteem, as well as developing self-management and self-control skills.

The aim of testing is to explore non-pathological psychical phenomena and to detect the influence caused by peculiarities of a person's

mental state on their actions in a particular moment, as well as to perform psychological analysis of the interested parties of the process.

Based on psychological and pedagogical forms of impact, a method was developed for evaluating cognitive and communicative levels of training of the engineering staff. The essence of the technique lies in the formation of understanding an engineer’s dependence on psychological culture that is defined as an ability to consciously learn scientific information, communication in groups, and to purposefully self-organize one’s behavior, to apply creative approach in fulfilling one’s professional duties on the basis of legal, moral, and ethical paradigms. The method is performed in two stages, which recur at various educational courses.

It is known that psychological culture is formed on procedural levels of psychical activity - cognitive and communicative ones. The cognitive substructure of the psychical activity of an engineer also includes cognitive processes that provide uptake and processing of the information perceived - social, educational, scientific, and industrial ones. Communicative abilities of a person also offer the effectiveness of communicative activity in interpersonal communication, as well as the psychological compatibility of such action. Communicative skills are thus an indispensable component of organizational and managerial skills. All these factors condition the importance of developing communicative abilities in students that play a significant part in the formation of a psychological culture of a future engineer (Leary 2004; Johnson and Johnson 2007; Antimonov 2009; Zotova 2014; Koroleva 2014; Evplova 2014; Kozlov 2017).

The suggested method includes elements of the formation of personal cognitive characteristics and aspects of the structure of communicative abilities. At the same time, communicative skills should be provided with more attention and effort because engineering students often lack these particular traits. Some of the essential methods of formation of communicative competences are training courses as well as individual and group sessions with psychologists. Also, psychological tests play an essential role - for instance, the Leary test “Interpersonal Diagnosis”, which is aimed at diagnosing interpersonal relations and personal traits that play an impor-

tant role in intercommunication with other people and other methods (Rosselli and Ardila 2003).

At the first stage, preliminary testing of students is performed, which is supposed to detect cognitive and communicative tendencies or difficulties of students. Further work should also be based on the groups in which students can be distributed according to test results. For example, four groups may be formed according to the detected strong and weak points in the sphere of cognitive competences and communicative skills (Table 1).

Table 1: Groups of students distributed in accordance with cognitive and communicative tendencies and difficulties

<i>Cognitive and communicative factors</i>		<i>Cognitive abilities</i>	
		<i>Strong</i>	<i>Weak</i>
<i>Communicative Skills</i>	Strong Weak	Group A Group C	Group B Group D

Formation of a significant number of groups with the estimation of strength and weakness aspects in the expression of factors, and also the application of an individual approach to students require much more attention from psychologists; consequently, it can be rational to apply an individual approach only in the most complicated cases. According to the results of the first stage, corrective measures should be developed with the aim of eliminating cognitive and communicative difficulties (Kozlov 2017).

The second stage of the method includes the application of corrective measures with the aim to form lacking competences and skills and also to support natural tendencies expressed by students in the sphere of education, science, and public relations.

As can be seen from the Table 1, group A is the strongest and the most promising group, which is formed by the students who have strongly pronounced cognitive abilities and a high level of adaptiveness and communicative activity. People from group A are leaders and can thus assist students from other groups. If students from this group are left beyond psychological work, there is a risk that a reverse effect may appear, and students from this group may consequently move to one of the further groups because their sincere interest and moti-

vation to cognitive and social activity would be left unwanted.

Students from group B who have some problems in the cognitive sphere but express their interest in social activities and who are natural extroverts, in fact, do not pose any difficulties. Most often, they need some support in additional interaction with teachers in terms of accomplishing educational tasks, and also some measures aimed at enhancing motivation and self-control in educational activities. They require active participation in social activities in their educational establishment with the simultaneous accomplishment of control measures in educational activities and avoidance of forming training debts. Social recognition in the form of certificates for merit and encouragement awards is thus considered as good stimuli for them (Sapegina 2016).

The portrait of a typical representative of group C is a quiet and reserved student who does not show much interest in social activity, but they are quite successful in their studies. If such a student does not demonstrate an interest in a social activity at all, there is no sense in engaging them in community responsibilities and collective works. Much more effective can be involved in such a student in scientific work and participation in scientific conferences and symposia. This exact sphere may adopt such a student to social activity and form specific communicative skills in them (Yang 2019).

The students from group D should also receive the closest attention from psychologists. This group consists of students who require an individual approach. So, it is very difficult to initiate the transfer of such students from group D straight to group A. That is why it is necessary to conduct additional research studies and analytical measures in order to assess their individual tendencies and motivational characteristics that allow them to define whether it is easier to distribute them to group B or group C.

The results of the application of the developed method and timely psychological correction are a gradual transfer of students from groups B, C, and D to group A, or at least a progressive advancement of students inside these groups with retaining their improvements in this or that sphere. The work in the application of the developed method should not have a single-use char-

acter, but a prolonged and consistent one, which requires performing a recursion of the two stages - psychological and pedagogical testing and psychological and pedagogical correction. Both of these stages should recur at various stages of the educational process, starting from the first grade accompanied by tracking the dynamics.

CONCLUSION

In terms of further measures aimed at the implementation of the suggested method, it is rational to start its application on the basis of one higher educational institution within one pilot group. The number of people in a pilot group should allow making statistically significant conclusions, and membership in the group should be of representational character. The work in this direction can be organized under the leadership of vice-principals for education with corresponding support from engaged psychologists. The application of the method is possible only if members of the teaching staff actively cooperate with each other and are ready to correct their teaching approaches. The application of the developed method also requires the engagement of professional psychologists as well as the staff of higher educational establishments. The useful output of such investments can be high because boosting the quality of students' professional training in cognitive and communicative spheres may become a severe stimulus to the overall development of the economy in a country. Consideration of students' psychological peculiarities can thus become leverage that would be able to increase the quality of professional training of modern engineers significantly. In conditions of lack of psychological follow-up, it is rational to initiate the development of mental skills in staff.

RECOMMENDATIONS

It is suggested that the content of this research paper be studied in other majors such as medical, psychology, Humanities and etc. to provide a general overview.

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REFERENCES

- Antimonov MY 2009. The formation of communicative skills in engineering students: Historical, philosophical, political and legal sciences, culturology and art history. *The Questions of Theory and Practice-Tambov: Gramota*, 2(3): 11-13 (In Russian).
- Agranovich AV, Puente AE 2007. Do Russian and American normal adults perform similarly on neuropsychological tests? Preliminary findings on the relationship between culture and test performance. *Archives of Clinical Neuropsychology*, 22: 273-282.
- Card SK 2018. *The Psychology of Human-Computer Interaction*. UK: Taylor & Francis Group Publications. <https://doi.org/10.1201/9780203736166>
- Evplova EV 2014. How to develop communicative skills in students? *Actual Problems of Pedagogy and Psychology*, 1: 41-45 (In Russian).
- Gorodetskaya IM, Shageeva FT, Khramov VY 2015. Development of cross-cultural competence of engineering students as one of the key factors of academic and labor mobility. *IEEE*, 15: 20-24. DOI: 10.1109/ICL.2015.7318015
- Johnson DW, Johnson RT 2007. Social skills for successful group work. *Educational Leadership N-Y*, 1: 29-33.
- Koroleva NV 2014. Communicative abilities as a factor of formation of psychological culture in engineer-pedagogue: Problem statement. *The Problems of the Territory's Development*, 5(73): 69-76 (In Russian).
- Kozlov VI 2017. Formation of Communicative Abilities in Managing Students-Development of Modern Education: Theory, Methods and Practice. *11th International Research and Practice Conference*, Cheboksary, 5 February, 2017.
- Leary T 2004. *Interpersonal Diagnosis of Personality: A Functional Theory and Methodology for Personality Evaluation*. Portland, Oregon: Wipf & Stock Pub.
- McMichael AJ 2013. Globalization, climate change, and human health. *New England Journal of Medicine*, 368: 1335-1343. <http://dx.doi.org/10.1056/NEJMr1109341>.
- Ministry of Education and Science 2016.
- Mongraphy EV, Basistaya YV, Dilman IS, Dmitrieva I 2014. *Professional Socialization of Young Students*. Volgograd: Volgograd Scientific Publication (In Russian).
- Sapagina TA 2016. Pedagogical aspects of communicative abilities' formation in students studying at pedagogic institutes. *Research and Methodological Electronic Journal "Concept"* 15: 366-370 (In Russian).
- Rosselli M, Ardila A 2003. The impact of culture and education on non-verbal neuropsychological measurements: A critical review. *Brain and Cognition*, 52(3): 326-333. DOI: 10.1016/S0278-2626(03)00170-2.
- Wickens CD, Hollands JG, Banbury S, Parasuraman R 2015. *Engineering Psychology and Human Performance*. USA: New York Psychology Press.
- Yang Z 2019. Psychological health course teaching mode based on students' high-order thinking ability development. *International Journal of Emerging Technologies in Learning*, 14(4): 101-112.
- Zotova IV 2014. Formation of Communicative Abilities in Students in Educational Process. The Problems and Perspectives of Educational Development. *5th International Research and Practice Conference*, City of Perm, 25-27 March 2014. Perm: Mercury, 1: 202-204.

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