

## **STUDY OF THE DEVELOPMENT OF THE USE OF COMMUNICATIVE TECHNOLOGIES IN THE EDUCATIONAL PROCESS OF ENGINEERS TRAINING**

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**Abstract.** Pedagogical science sees the specificity of higher engineering education in the fact that future engineers need not only to master the theoretical foundations of engineering calculations, but what is especially important for quality professional training, is to acquire stable abilities and skills to implement successful practical activities – readiness for independent professional improvement. At the same time, the development of communication technologies, a derivative of the needs of civil society, has accelerated markedly due to the forced physical isolation caused by the need to combat the Covid-19 pandemic. The transfer of knowledge in traditional forms between participants in the educational process, due to the dramatically increased mobility of the parties, is losing its effectiveness. The Internet, educational platforms, and social media have undeniably increased the speed and volume of information exchange. The authors of the article, having experience in using and evaluating the effectiveness of various communication technologies and tools, conclude that there is an obvious qualitative improvement in the digital competence of students.

**Keywords:** higher engineering education; communications; social media; distance learning; artificial intelligence

### **1. Problem statement**

“Student”, as a subject of the educational process, is naturally endowed with a unique continuum of mental traits, which requires precisely an individual approach by the “teacher” to identify his giftedness and abilities in achieving educational goals. As a consequence, didactics in general and pedagogical technologies of higher professional education in particular are increasingly becoming situational. That is, the vector of their system development tends to correspond to the actual features of real cognitive

processes. At the same time, the use of modern tools in communicative technologies of educational processes, allow in “on line” or “off line” modes to organize learning in such a way that depending on the situation (the actual giftedness and abilities of the student) to plan and adjust the rational way to achieve the vital for the individual educational goal.

In today's ever-changing world, higher vocational education is adapting quickly or slowly, but still adapting to innovation – introducing innovative technologies to transfer knowledge and skills in new situations for society. It is appropriate to recall Winston Churchill's famous quote that the only way to remain consistent in changing circumstances is to change with them, while maintaining the same dominant goal. John Dewey in his work “Democracy and Education” writes that life is in development, therefore, education must respond quickly to changes in the environment, to be in constant reorganization, reconstruction, transformation (Dewey1916).

Globalization and competition in the intellectual labor market, distance working and distance education, bring to the forefront a set of acquired competencies – the ability of an engineering graduate to continuously and independently improve his/her professional level. This is facilitated by flexible communicative learning technologies, which are inherently individual in their attitude to everything that makes up the content of the educational process.

The Internet has changed many aspects of modern society and social interaction. Along with the technological development focused on commerce, there has been the growth of social media, one of the modern forms of communication technology with a significant, constantly updated instrument that, because of its inherent mobility, reaches a huge audience (Ellison & Boyd 2013, pp. 151 – 172).

Naturally, the sphere of higher professional education, including engineering education, is saturated with the need for communication for the exchange of knowledge. Social media, with its considerable entertainment content, is also a tremendous educational resource and an arsenal of knowledge-sharing tools for participants. A prime example is You Tube, with its many scientific, educational, and informative channels sharing a variety of information that people turn to when they need to solve an engineering problem, or cook dinner, or take care of a plant. In You tube, as in university, the individual need for this or that quantum of information drives and motivates the individual's desire to learn what he or she personally needs to know. Social media allow you to find like-minded people, to show yourself off, to hear and see others. For example, for Ukraine as a state, it is an opportunity to form a civil society. For professional education, it is another tool for knowledge exchange, the operating technology of which is not yet clear.

Carr and Hayes define social media as Internet channels that allow users to freely interact and selectively represent themselves in real time or asynchronously with both broad and narrow audiences that value user-generated content and perceive interactions with others (Carr & Hayes 2015, pp. 46 – 65).

In our previous studies, it was revealed that students with a lower level in digital competencies experienced difficulties in communication when forced to switch to distance learning. Assessing the effectiveness of educational communications, under the conditions of increasing quarantine constraints, oriented the scientific and pedagogical staff of the two engineering departments to search for ways to improve the organizational component of distance learning. The results of the research revealed “white spots” in understanding the quality of educational content and its impact on the formation of future engineers' need for permanent improvement of their professional level, self-education and self-improvement.

Recent observations suggest that over the past year the level of informatization of the educational process has increased: educational platforms, social media – qualitatively improved, the speed and volume of information exchange has increased markedly. At the same time, many questions remain unanswered when investigating the quality and effectiveness of educational content, as well as ways to improve communication technologies, in this discussion is far from over.

## **2. Analysis of recent research and publications**

Studies and publications devoted to the study of problems of the effectiveness of social media tools in the communication process of distance learning in “on line” or “off line” modes allowed to form the main conclusion about the incompleteness of the discussion regarding content, technology, connections, mobility and other categories of the scientific problem of assessing the impact of social media on the quality of the organization of learning in engineering departments, including, in the forced distance learning. For the post-industrial global information society, it is important that students have the ability to use new information technologies in the study of various disciplines. The analysis of domestic and international experience in the development of professional education confirms the trend of increasing influence of social media as a tool for knowledge transfer.

In Johnson's (2015) study, Twitter fostered an engaging learning environment. Students achieved the required level of mastery as they enthusiastically participated in answering questions, checking responses from friends on Twitter, or adding a line to collaborative correspondence.

The impact of distance education form on higher engineering education is analyzed in the study. S. Iqbal, et al. note that “...Since the presence of students in laboratories is very important in engineering courses, theory should be complemented by practical exercises. In this regard, virtual and remote labs can play an important role in bridging the gap between theory and practice in online courses” (Iqbal et al. 2015, pp. 705 – 709).

Digital competence is a necessary component of future engineer's professional competence under the conditions of society informatization. The introduction of new communicative technologies and tools in the organization of students' distance learning activities, including the use of social media in the study of disciplines of

general engineering cycle and disciplines of professional specialization, positively affects the formation of professional competencies and development of creative abilities (Nikolaenko, Bondar, Bulgakova, Vasileva & Vartukapteinis 2021).

That there are significant positive connections between chatting and online discussion, file sharing and knowledge exchange, and the entertainment and enjoyment of student education was established by Mustafa I. et al. (2016). The researchers state, "...file sharing based on social networking tools are important predictors of knowledge sharing" (Mustafa et al. 2016, pp. 14 – 27). Thus, according to the authors' beliefs: "...educators working in educational settings should encourage students to use social networking tools for online chatting, discussion, and file sharing, as this will go a long way toward sharing knowledge and then enhancing learning, as knowledge sharing is directly related to student learning".

The results of the data analysis show that 99% of respondents or almost all KFUPM students use one or more social networks. Most respondents (96.7%) have more than five years of experience using social media. About two-thirds of respondents are at the undergraduate level, and one-third are at the graduate level. The bachelor's degree respondents were evenly distributed among the various classes of students. However, half of the bachelor's degree respondents were from the College of Engineering and Applied Engineering, as this college has the largest number of students. The results show that the most common social media tools used by respondents for communication and discussion are WhatsApp (92.5%), YouTube (82.8%), followed by Facebook (74.4%).

One of the main tasks of German universities has been defined as preparing future professionals to be able to solve problems and find solutions by putting digital competence into practice as a vital skill set (Bond, Marín, Dolch, Bedenlier & Zawacki-Richter 2018). Various policies, initiatives and strategies are currently being proposed in Germany aimed at innovating educational technology in higher education. They state, "...education and learning processes are still largely teacher-centered...". At the same time, the results of faculty surveys show that they use the distance education institutional platform (Stud. IP) mainly as an organizational tool for their classrooms, such as checking class enrollment, planning seminar topics and downloading materials, rather than promoting motivated students and advanced learning technologies within the course (in a blended or online format) or actually as a 'learning management system' that is considered more complex and necessary. Further: ...in terms of usefulness, students find search engines, word processing, Stud. IP and computers outside the university "very useful" and lecture notes, cloud storage, Stud. IP forums and instant messaging "very useful". To increase the use of communicative educational technologies for teaching and learning, sound strategies for higher education institutions in Germany are suggested.

Carr et al. in their study proposed and tested an initial model for online education through social media. Because educators need web-based tools to improve, educational

content-the model provides a framework for understanding how learning can occur outside of the sterile and controlled walls of conventional classrooms, grounding the concept of critical factors affecting student learning through social media (Carr, Zube, Dickens, Hayter, Barterian 2013).

Vareberg, K. R., Luo, Z., Westerman, D., Bartels, M., & Lindmark, P. (2020) have explored the informal possibilities of mediated communication between faculty and students, establishing its educational value that cannot be overlooked or ignored. As the communicative digital toolkit expands, technologically mediated extracurricular communication may become an even more important component of knowledge exchange among educational participants. Teachers who address students by name or are aware of response times for messages can increase students' level of motivation in their work. When students perceive themselves as individuals, they are more motivated. Students have positive emotions that motivate their learning, development of skills, abilities, and creative aspirations. Taken together, this has practical implications for improving pedagogical excellence.

Kelly, Stephanie E. and Westerman, David K. (2016) analyzing the features of distance education are looking for answers to a number of questions: Is digital communication an effective way to learn? In distance learning, do students learn in the same way as in a classroom – directly with the teacher or worse? Should informational learning products be created other than classroom instruction? Are distance learners satisfied with the teaching-learning experience? Are distance educators satisfied when contact with students is limited? Thus, pedagogical communication researchers are concerned with how the use of ever-evolving technology can affect communication, learning, motivation, and instruction.

In analyzing communicative educational technologies, researchers draw attention to a technology that could find wide application in distance education – the robot. Unlike the avatar, which is an image of a person, the robot is a computer-based communication system, known as collaborative virtual environments (CVE), allows geographically separated people to interact verbally and non-verbally in a shared virtual space in real time (Bailenson, Beall, Loomis, Blascovich & Turk 2004, pp. 428 – 441). In situations where distance interferes with the physical presence of a human teacher (limiting face-to-face interaction), robots may be better than computer tutors because they can inhabit the same space as the student, potentially increasing engagement and facilitating interaction (Saerbeck et al. 2010, pp. 1614 – 1622).

S. V. S. Chaudhary & Niradhar Dey (2013) due to the changed needs of modern society, draw attention to the need to improve traditional assessment practices in both face-to-face and distance learning systems. Assessment should be linked to student learning and skill development. Research substantiates the need for systematic control and self-monitoring of students' progress towards creative cognitive activity, with the main task of all types of assessment of their knowledge being to check the achievement of the ultimate goal of professional training – the formation of a multicomponent

structure of technical thinking, engineering learning and cognitive skills (Nikolaenko, Bondar, Bulgakova, Vartukapteinis 2020, pp. 1355 – 1363).

Bakerson, M., Trottier, T & Mansfield, M. (2015) note that due to the explosive growth of the online learning environment and the concurrent ongoing demand for accountability, the need to identify and implement best practices for assessment in online learning environments is increasing dramatically. The authors of the study view knowledge assessment as a systematic process of documenting learning through measurable evidence. In their view - the success of a quality online learning environment depends on the use of rapid and objective assessment technologies.

Thomas Howard Morris, Matthias Rohs (2021) found that the convenience and accessibility provided by digital technologies have proven to be very useful for professional development, especially for professionals who work in fields where there is a constant need to adapt to changing work environments. Since adaptation to production conditions has been proposed as absolutely necessary for professional experience (Ward, Gore, Hutton, Conway, Hoffman 2018, pp. 35 – 50) we can say that digital technologies proved to be a valuable tool to support the development and preservation of professional knowledge. The analysis of the results of the study of distance learning and scientific independent work of students indicates that achieving efficiency in the formation of readiness for professional self-development is possible if the pedagogical conditions of mandatory individual approach are met (Nikolaenko, Bondar, Bulgakova & Dukulis 2020, pp. 1364 – 1372). According to the results of the surveys, the most important skills for achieving the goals of independent learning and research activities of future engineers have been identified – the ability to find, analyze and interpret information in the process of learning and research activities.

Social relations, characterized by the mobility of the population and the requirements of the labor market to obtain multiple education, increase personal professional educational level, contributed to the emergence of distance and correspondence forms of education. This, in turn, thanks to communication technologies, contributed to the introduction in the educational process – educational platforms, educational and informational portals, which are part of the information and educational environment (Nikolaenko, Bondar, Bulgakova, Shymko, Dukulis 2021). The effectiveness of this tool of knowledge transfer is actively researched. For example, in the largest pedagogical university in Poland the functionality of the e-learning platform and self-assessment of their own digital literacy were evaluated. The aim of the study was to assess three areas: the functionality of the SELI platform, individual e-learning experience, and digital literacy. The survey was addressed to teachers and students. Based on the analysis, two groups of platform users were identified. One third of the users have a diverse e-learning experience, which corresponds to their digital literacy. The remaining two thirds of the respondents need additional training in the assessed areas. Analyzing other similar studies, Tomczyk and al. concluded that successful e-learning also depends on increasing motivation to participate

in e-learning and improving self-learning skills (Tomczyk, Potyrała, Włoch, Wnęk-Gozdek, Demeshkant 2020).

### **3. Research goal**

Evaluate the effectiveness of social media tools in the communication process of higher professional education, the availability and usefulness of existing methodological support, as well as the impact of social media on the quality of the educational process in engineering departments, including its forced distance form.

### **4. Research methods**

The study of the effectiveness of social media tools in the communication process took place in two stages and was conducted in the engineering departments of agrarian universities.

The first phase aimed to assess the extent to which participants in the educational process were engaged in communication through social media. In this phase, respondents were asked to rate their engagement in social media on a five-point Likert scale, as follows: 1 – “never”; 2 – “very rarely”; 3 – “rarely”; 4 – “often”; and 5 – “constantly”. There were 186 students and 37 faculty members who participated in the survey.

The second phase was aimed at determining the effectiveness of the respondents' use of social media tools. At this stage, a survey was conducted that included responses to the following statements: 1 – “absolutely disagree”; 2 – “disagree”; 3 – “neither agree nor disagree”; 4 – “agree”; 5 – “completely agree”. A total of 167 students participated in the survey.

The survey was conducted remotely. The first phase was conducted in October 2020, and the second in April 2021. Respondents were sent a questionnaire and a list of judgments about the elements of the study through the training and information portal. The main research tool chosen was the summative assessment method based on the Likert scale (Likert scale). The study was conducted in accordance with accepted standards of social psychology. Reliability analysis of measurement scales was performed according to Cronbach's alpha coefficient, using “IBM SPSS Statistics” package.

### **5. Novelty of the study**

For the first time, using the methods of social psychology, the results characterizing the effectiveness of the use of social media tools in the educational process of engineers' training, aimed at improving the university engineering training, have been obtained.

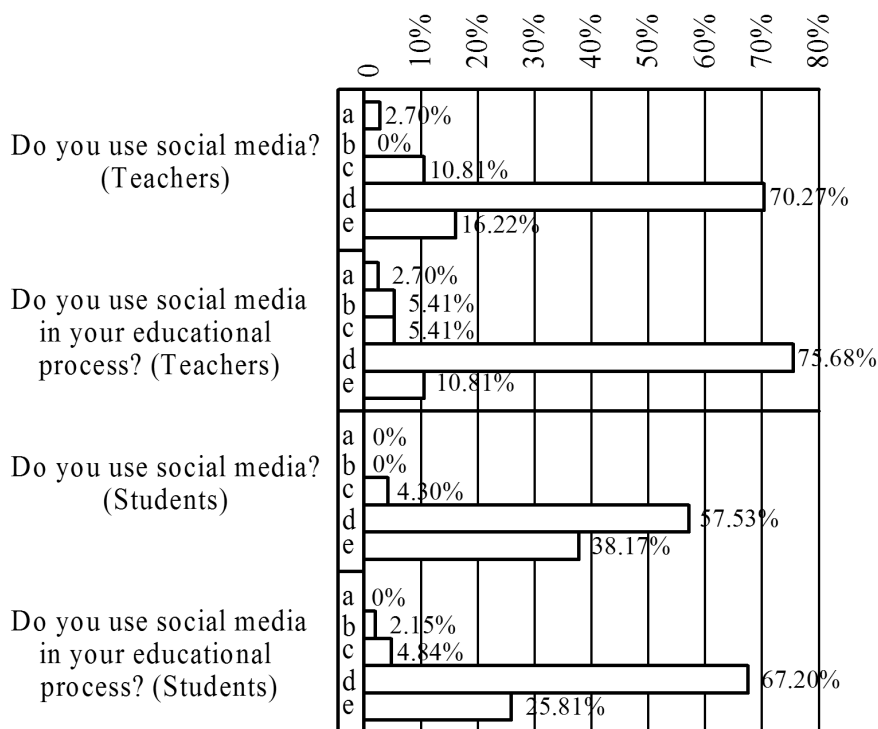
### **6. Presentation of the main material of the research**

The rapid, by historical standards, spread of information and communication technologies in the sphere of higher professional education, including engineering education, has led to the transformation of the content and orientation of interpersonal

communications of participants in the educational process (Ellison & Boyd 2013, pp. 151 – 172). With the advent of the Internet, knowledge organized for use in information networks has become an important source of information for individuals and society. Further, the pluralism of positions and interests of the individual and society, multiplied by the massiveness of information and educational flows, manifests itself in a new, special tool of communication technologies – social media.

In connection with the development of the modern information society, the need to study the role of social media as a tool of educational technology, i.e. one of the instruments of knowledge transfer, has arisen. The latter is especially relevant in view of the intensified, prolonged pandemic influence of mobility factors and the self-isolation of participants in the educational process.

In accordance with the logic of achieving the chosen goal – to evaluate the effectiveness of social media in the educational process, including the distance learning of engineering disciplines, the first stage of the study was to find out the



**Figure 1.** Involvement of participants in the educational process in communication via social media

degree of involvement of students and teachers in social media. And also, to get an idea of how fully the participants use social media specifically for educational purposes. At this stage, teachers and engineering students were interviewed. Respondents were asked to answer two questions. First, “Do you use social media?” and second, “Do you use social media in the educational process?”. The questions were sent to the respondents by personal e-mail, the main part of the target audience participated in the survey remotely. The survey involved 186 students and 37 scientific-pedagogical employees of the engineering faculties of NULES of Ukraine. Figure 1 shows the analysis of the survey results.

“Often” and “very often” use social media – 96.24% of the student audience, at the same time 93.01% “often” and “very often” use social media for educational purposes. Teachers actively using social media – 86.49% (10.81% “very often”, 75.68% “often”); also using in the educational process – 86.49% but already with a distribution: 67.20% “often” and 25.81% “very often”. Analysis of the results shows greater involvement in social media of the student audience compared to the teachers, which can be explained by the age difference and, accordingly, a kind of “digital divide” observed in comparing the digital literacy of different generations of social media users (Bailenson, Beall, Loomis, Blascovich & Turk 2004, pp. 428 – 441; Kelly, Stephanie & Westerman 2016). In this case, we see a need for additional seminars with increased motivation to encourage teachers to actively use IT technologies in the learning process.

The second stage of the study involved only students (167 people); it was planned to study the perception of social media tools in educational projects; to establish the presence and degree of usefulness of social media influence on the qualitative structural components of the learning process in engineering departments; the research tool chosen was a survey and the method of summative assessments based on the Likert scale. The questionnaire consisted of prepared twenty judgments. Table 1 shows the list of judgments offered to the respondents.

**Table 1.** List of judgments offered to respondents

| Judgments                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------|
| 1. Do you agree with the judgment that trusting communication with participants in the educational process is important to you; |
| 2. Do you agree with the judgment that social media helps you organize and coordinate learning activities;                      |
| 3. Do you agree with the judgment that social media facilitate faculty-student collaboration;                                   |
| 4. Do you agree with the judgment that you use social media interactively to get advice in difficult learning situations;       |
| 5. Do you agree with the judgment that social media help students collaborate with one another;                                 |
| 6. Do you agree with the judgment that professors who actively communicate with students on social media are more trusted;      |

| Judgments                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7. Do you agree with the judgment that social media allow participants to come to a consensus and foster a coherent understanding of the tasks relevant to your professional education; |
| 8. Do you agree with the judgment that social media facilitates your participation in informal groups to discuss issues that interest you;                                              |
| 9. Do you agree that social media contribute to the competencies you need for your future work;                                                                                         |
| 10. Do you agree that social media help you share knowledge with others in the educational process;                                                                                     |
| 11. Do you agree with the judgment that social media contributes to your professional self-development and self-education;                                                              |
| 12. Do you agree with the judgment that you consult social media in the performance of academic tasks;                                                                                  |
| 13. Do you agree with the judgment that social media is convenient for finding answers to your questions;                                                                               |
| 14. Do you agree with the judgment that you find controversy on social media forums interesting;                                                                                        |
| 15. Do you agree with the judgment that you have a positive experience with social media communications;                                                                                |
| 16. Do you agree with the judgment that teachers with little digital competence are of no interest to you;                                                                              |
| 17. Do you agree with the judgment that you know all about cyberbullying, Internet addiction, and Internet fraud;                                                                       |
| 18. Do you agree with the judgment that to a greater extent social media You use for recreation;                                                                                        |
| 19. Do you agree with the judgment that social media contributes to your digital literacy as one of the keys to a future engineer;                                                      |
| 20. Do you agree with the judgment that you use social media in a collaborative environment with meaningful tasks.                                                                      |

The survey was conducted remotely in April 2021. The groups of students of industrial engineering and agroengineering specialties participated. Results – answers to the judgments were evaluated on a five-point system. Table 2 shows the judgment responses on the Likert scale.

**Table 2.** May 2020 Likert Scale Judgment Responses

| No judgments | absolutely disagree | disagree | nor agree, nor do I agree | agree | absolutely agree | Rank |
|--------------|---------------------|----------|---------------------------|-------|------------------|------|
| Judgments 1  | 0                   | 1        | 11                        | 97    | 58               | 4.27 |
| Judgments 2  | 0                   | 1        | 12                        | 98    | 56               | 4.25 |
| Judgments 3  | 0                   | 0        | 14                        | 109   | 44               | 4.18 |
| Judgments 4  | 1                   | 4        | 11                        | 113   | 39               | 4.13 |
| Judgments 5  | 0                   | 1        | 10                        | 104   | 52               | 4.24 |
| Judgments 6  | 0                   | 1        | 11                        | 103   | 52               | 4.23 |
| Judgments 7  | 1                   | 3        | 7                         | 110   | 47               | 4.21 |
| Judgments 8  | 1                   | 4        | 13                        | 111   | 39               | 4.11 |

|               |    |    |    |     |    |      |
|---------------|----|----|----|-----|----|------|
| Judgments 9   | 2  | 2  | 11 | 115 | 39 | 4.16 |
| Judgments 10  | 2  | 2  | 19 | 103 | 43 | 4.13 |
| Judgments 11  | 1  | 2  | 10 | 115 | 40 | 4.16 |
| Judgments 12  | 0  | 1  | 10 | 104 | 52 | 4.24 |
| Judgments 13  | 6  | 4  | 21 | 109 | 33 | 4.06 |
| Judgments 14  | 1  | 0  | 15 | 121 | 31 | 4.10 |
| Judgments 15  | 17 | 11 | 46 | 83  | 27 | 3.86 |
| Judgments 16  | 6  | 7  | 21 | 109 | 30 | 4.01 |
| Judgments 17  | 1  | 0  | 15 | 121 | 31 | 4.10 |
| Judgments 18  | 6  | 6  | 21 | 109 | 31 | 4.02 |
| Judgments 19  | 1  | 5  | 11 | 115 | 39 | 4.11 |
| Judgments 20  | 5  | 5  | 21 | 110 | 31 | 4.03 |
| Average value | 3  | 3  | 16 | 108 | 41 | 4.13 |

“Absolutely agree” and “Agree” – 87.43% of the respondents answered. The average score across the sample was 4.13, with coefficients ranging from  $r_s = 0.39$  to  $r_s = 0.71$ . Statistical checking of the results was carried out by calculating correlation coefficients for each judgment. The analysis of the data obtained during the survey of 167 students using appropriate mathematical apparatus of scientific and applied research (IBM SPSS Statistics) allows us to state the reliability of the questionnaire used as a research tool, as Cronbach's alpha coefficient was  $\alpha = 0.765$ .

## 7. Conclusions

Due to the significant involvement of both students and faculty of higher professional education institutions in social media, the latter are being introduced into educational processes as a promising communication tool with a synergistic effect and complementary to existing educational platforms. The study revealed:

- first, the considerable popularity among students of social media resources, most of which are used for entertainment and recreation, but which have great potential in the educational sphere;

- second, the achievement of a highly effective communicative component is hampered by the lower digital skills of teachers compared to students (in this study, the “digital divide” was more than 10%);

- thirdly: looking back at the ever-increasing number of communication channels available to the individual, to the individual, multiplied by the wide range and significant volumes of information required by him – the individual – it is quite realistic to see the invasion of artificial intelligence in the territory of communication “teacher ↔ student”.

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