

Distance Communications in the Research Activities of Schoolchildren*

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Abstract. This article discusses the model of organization and implementation of a research project for a team of schoolchildren in the senior grade of a secondary school with intensive use of distance communications. The paper offers the research project model for the schoolchildren team within the extracurricular activities for the high level of the secondary school. The models of educational projects are analyzed in short. The technology chosen for the educational research project is the one most often used in the professional activity of scientific and technological companies. The distance educational technologies used in project teams are analyzed. The offered model is tested in a pedagogical experiment “DIY Data science”. The experiment performance is discussed. Universal educational skills were developed among schoolchildren (mathematics, informatics, chemistry) which can be used in further professional activity. The article offers the model of distance communications for the work of the project team. In this model, it is assumed that all types of remote interaction, including the reflection stage, are used.

Keywords: Schoolchild Research Activities, Distance Communications, Project Method, High Level of a Secondary School, Education.

1 Introduction

A modern schoolchild will live in a digital society, he should be competitive in the labor market and be needed by society. Research activities for schoolchildren are intended to form meta-knowledge and competencies which can be useful in further life. Building sustainable distance communications while researching by a group of pupils is a relevant pedagogical task.

The purpose of this article is to discuss a model of the schoolchildren’s distance communications when they carry out the research project.

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2 Theoretical part: researches, projects, distance communications

Fig. 1 shows that the top trends of social development can be a challenge to the modern school, and shows their influence on the development of personal qualities of students.

Digital Society: On July 22, 2000, the Group of Eight countries adopted the Okinawa Charter of the Global Information Society [1]; the State Program "Information Society" is being implemented in Russia [2]. To live in such a society, a person, in addition to knowledge and competence, must also manage information technologies.

Complexity: With the constant growth of information flows, a modern person should be able to find, process, and decide on the necessity of the information to be used (generate new information).

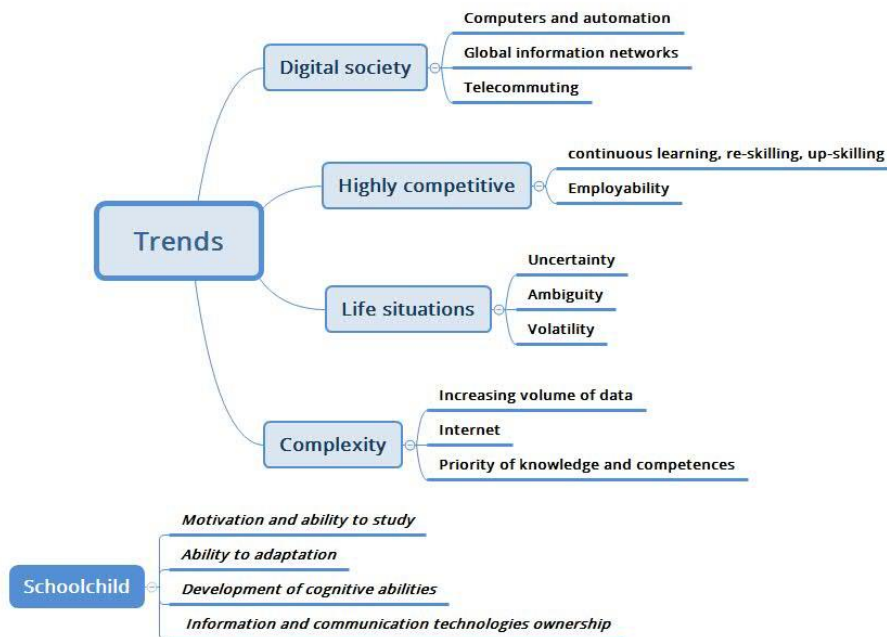


Fig. 1. Trends of development of society and their influence on personal qualities of the schoolchild.

Research activity is one of the effective ways to build personal qualities in the schoolchild, which are necessary for future life: motivation, ability to study, leadership, teamwork, communication skills, adaptability, cognitive skills, the impact of the activities [3].

The research activity of schoolchildren at the secondary school is provided through the project activity. There is a wide range of opinions (Fig. 2, 1 – [4], 2 – [5], 3 – [6],

4 – [3]) defining the meaning of a concept of the educational project in the pedagogical community. As the future professional life of the schoolchild involves participation in various professional projects, in this article we will adhere to the definition given in the Russian and international standards: the project is "a complex of the interconnected actions directed to the achievement of unique results in the conditions of temporary and resource restrictions" [7].

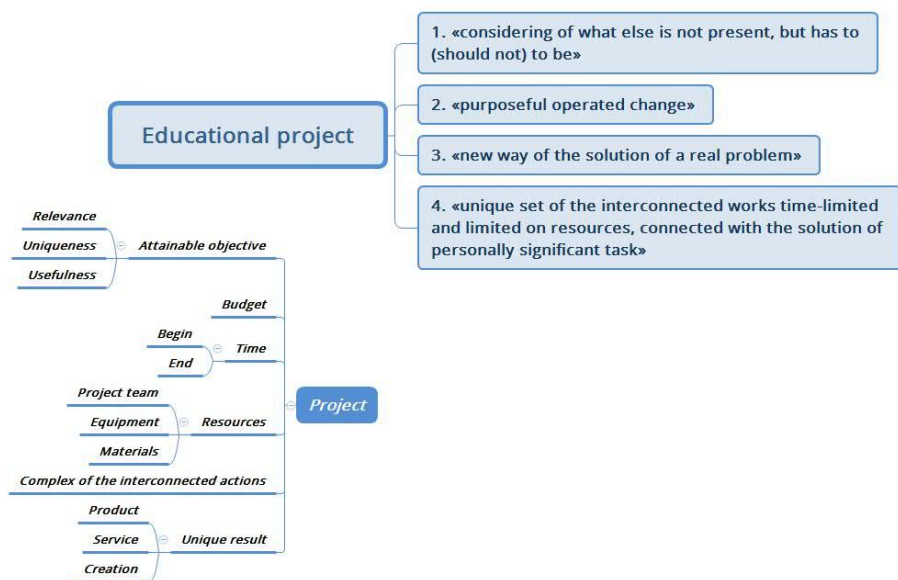


Fig. 2. Educational project and standard project.

Fig. 3 shows distance communications in education [8] and the project team with the indication of possible means of their realization.

3 Pedagogical Experiment: “DIY Data Science”

The idea of an experiment arose during an informatics lesson when a schoolchild showed interest in the new profession of "Data Scientist" [9] (interest in information technologies, artificial intelligence, the profession of the future, the programming at Python).

In the course of the discussion, it turned out that this profession demands knowledge of mathematics, informatics, and also subject orientation (physics, biology, chemistry). And a lot of the necessary knowledge goes beyond the pages of textbooks.

Students had a sustained interest (motivation, desire to learn and there was a leader). The project team was formed. Pupils had to study some technologies of artificial intelligence used in this profession.

The hypothesis of a pedagogical experiment consisted in the following. The project team had to investigate one technology of artificial intelligence (artificial neural network) from the three points of view:

- at the level of programming without the use of special libraries;
- at the level of software use;
- at the level of using mathematical statistics.

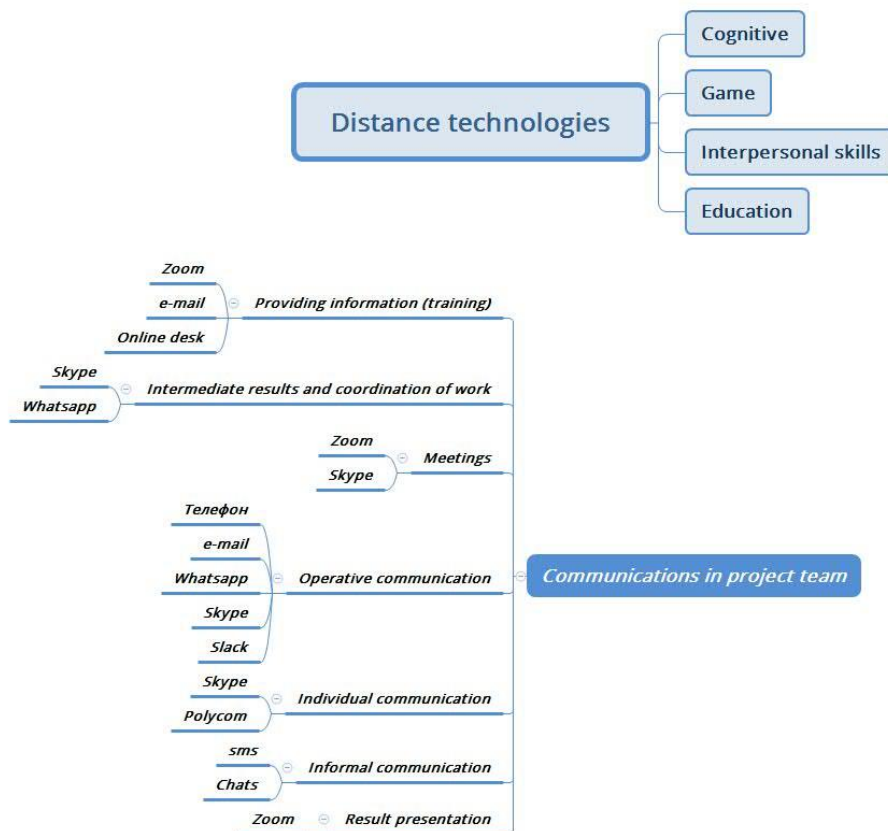


Fig. 3. Distance technologies in education, and communication in the project team.

The research project aimed to develop and train an artificial neural network to solve a specific scientific challenge, to examine and report the obtained results of research activity. The project had to be carried out within extracurricular activities.

The collaboration technology [10, 11] was used to experiment. The research was carried out by the project method [12]. One of the pupils became the project manager. The teacher acted as an expert and a consultant. Both face-to-face meetings and distance communications were used for interaction between the project participants.

4 Result of the Experiment

The choice of a topic for the educational project was influenced by the scientific interests of the author. The purpose of the educational project was to predict the reactivity of organic compounds of a certain class in reactions with radicals in a liquid phase according to experimental data using the artificial neural network.

The work is relevant because the knowledge of the reactivity of organic compounds in elementary reactions is the component in the development of new drugs and the development of technological processes in chemical production. The obtained results can be applied by chemical engineers and scientists, thus providing for the usefulness of this work. The uniqueness consists in the creation of an intellectual property object.

The result was achievable – similar results were received for reactions with other classes of organic compounds in liquid and gas phases [13, 14]. The planned time for the project implementation was 4 months (+ months in case of force majeure).

There is a big variety of models of implementation of educational projects [15] which can be summarized as shown in Fig. 4. The organization of the implementation of the educational project was constructed according to the scheme recommended in PMBoK [16]. It should be noted that the scheme recommended in Aligle [17] is more convenient for educational projects. A good educational environment can be provided by Moodle [18].

The motivational unit has to include a component of vocational guidance. A formula for success has to be articulated. In our project, we had a lesson "Data Scientist: introduction to a Data Science, perspective, the formula for success". The project manager received training on the topic "Project management" [12].

Improved knowledge of pupils consisted in studying the topics "Chemical Reactions and Reactivity", "Enthalpy of Chemical Reaction and Reactivity", "Function of any number of variables", "Approximation of functions", "Functions of any number of variables and artificial neural networks", "Programming of artificial neural networks".

The practical unit included the independent study of the project participants in three directions: development of the program of modeling of artificial neural network in a programming language, use of the emulator of the artificial neural network, use of regression model for the solution of the task.

The detailed model of the educational project is presented in Fig. 5.

Special attention was paid to the realization of the basic principle of teamwork in the project: information has to be available to all. The use of Peer education between pupils and the teacher (organizational dialogue) [19] was the second moment that to a large extent promoted mainstreaming of the gained knowledge.

The received results and the team collaboration in discussion and defense of the project results were analyzed. Results of the project were presented at the conference "Noginsk. Step into the future" (Section "Eureka", prize-winner, Section "Physics", participant) and published in [20].

At the reflection stage, the accent was put on the achieved individual results and estimates of their contribution to the results of the teamwork (personal success and success of the team).

Remote communications were actively used during all stages of the project.

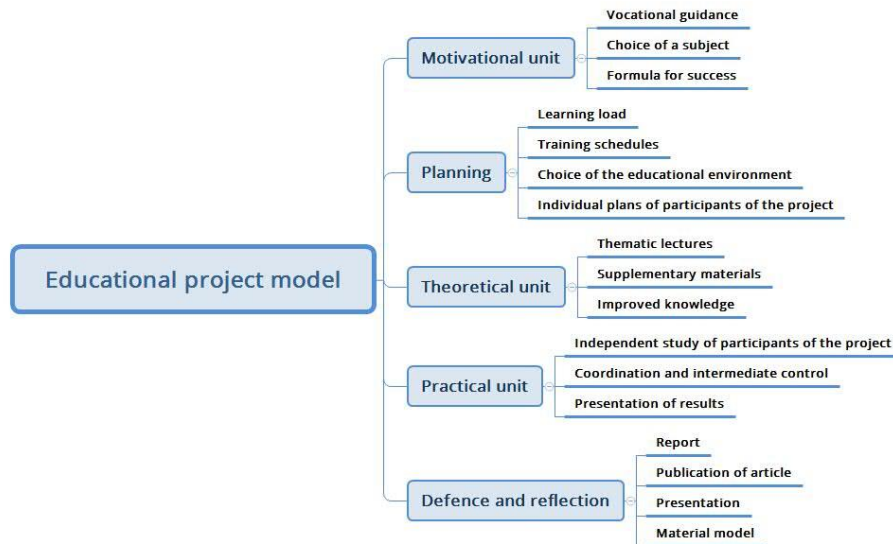


Fig. 4. Educational project model.

5 Model of Distance Communications

Fig. 6 shows one of the possible models of distance communications performing the research project in the telecommuting team.

At the initial stages of the project the relations between the participants were based on the principle of the subordinated cooperation, and at the other stages – by the principle of equal cooperation.

Synchronous distance communications in the project were tied to the strict schedule. The project teamwork was based on the principles of discipline and obligation.

Although the interaction through the asynchronous communication "Online board" is intended for realization of the principle "all information on the project has to be delivered to all participants just in time", in this project it was practically not used.

When using any model of distance communications, it is impossible to exclude face-to-face interaction of the project participants even though the main shortcomings of distance learning in this project were minimized (motivation, self-discipline, chaotic interaction).

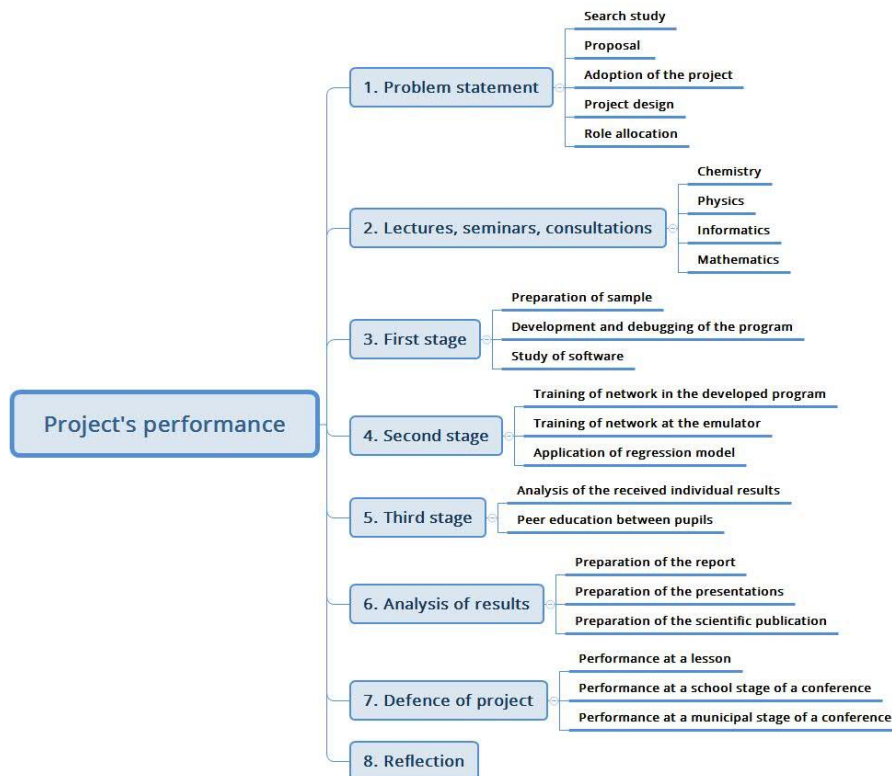


Fig. 5. Project's performance.

6 Conclusions

The author offers the research project model for the schoolchildren team within the extracurricular activities for the high level of the secondary school. The models of educational projects are analyzed in short. The technology chosen for the educational research project is the one most often used in the professional activity of scientific and technological companies. The distance educational technologies used in project teams are analyzed.

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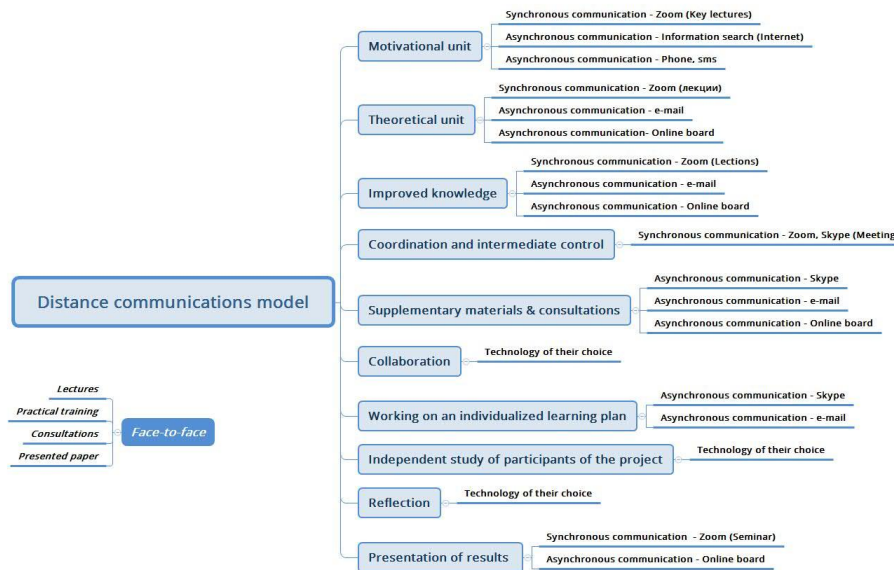


Fig. 6. Model of distance communications of the project team.

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