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Teaching Students To Program In A Virtual Collaborative Environment

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Abstract: The article describes the model of organizing group interaction of students in developing joint projects within the framework of extracurricular programming activities using a multimedia programming environment. The author proposes a technology for organizing group interaction and provides an example of step-by-step group development.
Keywords: group learning, programming, project activities.

The learning of programming is a difficult process. To become good programmers, students must acquire a series of capabilities that go well beyond knowing the syntax of a programming language, they must understand its abstract concepts, and this difficulty translates into a lack of motivation for learning. We propose the use of a collaborative virtual environment in a way that allows students to program within the context of a business-like professional programming environment, akin to that found in a software house, in order to make abstract concepts and requirements more concrete and therefore increase the learning effectiveness and students' motivation.

The ability to coordinate human efforts towards a common goal can be supported by the use of virtual environments, since these allow for greater contextualization of collaborative activities. Some approaches try to simulate real environments, while others employ virtualization as a way to render concrete concepts that are usually seen as abstract, or whose rendering in concrete form is not viable due to physical or economical constraints.

In the next section of this paper the motivations for this work are described. Then we introduce the concepts of Multi-User Virtual Environments and Collaborative Learning Environments, the features that result from the union of both, and some illustrative examples. Finally, we present the results of our work so far, and the work plan we will follow aiming to increase the learning effectiveness and students' motivation.

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Virtual learning environmemts contain obvious affordances for collaborative learning. Dillenbourg [11] point the features that a virtual learning enviroment should contain to support colaborative learning:

• Structuring collaboration: the teacher does not simply ask the group members to do some task together, but specifies a scenario. A scenario includes several phases and, at each phase, the team has to produce something and the team members have some role to play. Roles such as criticising the partner's proposal, summarising what the partner has read, probing the partner for justifications, are expected to trigger productive interactions.

• Regulating interactions: even if the efforts to structure collaboration increase the probability of occurrence of productive interactions, there is no guarantee that the interactions do actually occur. Therefore, collaborative learning would benefit from some external regulation, generally a tutor. The role of this tutor is not to intervene at the task level, but to make sure that all group members participate, to point out contradictions between group members which have not been noticed and so forth. Regulation is however difficult when interactions occur in the virtual space: a teacher cannot for instance regulate synchronous communication in 10 teams of 3 students. Researchers are now developing tools to help teachers to regulate groups and/or to help groups to regulate themselves

The main feature of the federal state standards of basic general education of the new generation is undoubtedly focused on the development of the student as an individual and deviation from the standard model of teacher-student pedagogical interaction organization, in which the teacher plays the greatest role. Modern trends in the development of education have led to the introduction of a new model of interaction, within which the teacher does not provide specific knowledge, but provides methods and techniques for acquiring new knowledge. The teacher's main task is not to give a lot of knowledge, but to teach students to independently discover new knowledge, analyze, and show excellent results.

Within the framework of developing this model of pedagogical interaction, the application of personalized learning technologies takes place. Some of them are realized as a student's individual activity, while others, on the contrary, are realized as group interaction. A student's individual activity undoubtedly leads to the formation of critical and logical thinking, skills in solving various problems through the rational use of their own strengths, knowledge, and skills. However,

individual activity has a significant drawback - the lack of interpersonal interaction and, as a result, the lack of teamwork skills. Group activity allows students to unite, identify their leadership qualities, and teach them how to work in a team. Organizing this type of interaction also allows students to improve their communication skills and learn to defend their position with arguments, critically analyze the positions of each other's team members.

It should be noted that using only one of these approaches to organizing educational activities in the educational process is not correct. Individual and group activities of students do not replace each other, but only complement and give the teacher additional tools for the development of the student's personality.

This approach to organizing the educational process is used within the framework of the Scratch 2.0 programming multimedia programming courses implemented at the 89th Moscow State Pedagogical University in Krasnodar. Within the framework of these courses, students are engaged in creating diverse projects that allow for the development of creative thinking.

Students' project activities consist of two important components:

- Individual project activities;
- Group project activities.

The main distinguishing feature of a student's individual project activity is creativity, creative uniqueness, and originality of implementation. In the process of working on a specific individual project, the student can adhere to a specific algorithm.

In the process of writing an individual project, students develop several important skills:

- The ability to construct an algorithmic model of a problem problem;
- The ability to find mistakes;
- The ability to analyze the received data and correct scripts;
- Skill in working with multiple sprites and different software blocks simultaneously.

In doing so, the student consolidates the knowledge acquired during the theoretical and practical classes, summarizes them and groups them into a single, holistic structure.

Group work also plays a significant role in the process of programming instruction, primarily focusing on developing communication skills and collective activity.

In the process of group project activities, skills and abilities such as:
Collective creative work skills;
The ability to analyze the assigned task;
The ability to distribute functions in a group, to divide the overall work into several people;
The ability to engage in creative interaction.
Technological breakthroughs in the field of artificial intelligence, robotics, the Internet of Things, nanotechnology, biotechnology, materials science, energy storage and storage are causing fundamental changes that have encompassed all spheres of modern human life. The world is on the threshold of the fourth industrial revolution, the systems of production, consumption, transportation and delivery of products are being improved. Modern people study, work, and communicate in a digital society.
There is a problem of the humanitarian culture of modern specialists interacting in the virtual-real space. One of the ways of humanitarian interaction in the field of software development is collaboration.
Collaboration refers to the philosophy of interaction between people working together to achieve a specific product or goal.
Collaborative learning is aimed at increasing the individual success of participants while focusing on the quality of interpersonal relationships in the proposed activity. This method contributes to the acquisition of cognitive and social skills that are not innate. In a collaborative learning environment, responsibility is constantly shared among all participants, and their actions influence the final outcome.
Our research aims to justify and develop a model for the formation of social competence as a pedagogical system, the system-forming factor of which is the social order. The research was conducted at the Buryat Institute of Information and Communication of the Siberian State University of Informatics and Communications.
The functional model for developing social competence in future programmers includes blocks: target, content, organizational-activity, and results-criteria.
The target block takes into account students' requests, the professional standard, and the employer's requirements. To identify students' requests, a survey and testing were conducted, which allowed us to determine the communicative and organizational abilities of senior students. It was found that 90% of students have low and medium communication skills, they want to

develop them, as these skills contribute to personal growth and increase their chances for successful employment.

The content block contains the structural components of the model: cognitive, personal, behavioral, motivational, and emotional-volitional. Under these components, we understand: cognitive - the formation of knowledge about the psychological foundations of social interaction in real-virtual communication; personal - the formation of personal qualities; behavioral - the formation of social skills; motivational - the formation of motivation for interaction; emotional-volitional - the formation of self-regulation skills.

The model is based on personal-activity, systemic, and competency-based approaches.

The formation of social competence takes place in the process of personality socialization. A personal approach is realized through the student completing an individual assignment in a group. In the process of collaborative electronic interaction, the student's personal and professional growth occurs.

The formation of competencies is impossible without an activity-based approach, as only in the process of activity occurs the development and socialization of the individual. In the process of collaborative electronic learning, students work in a team, thereby actively developing social skills necessary for the professional activities of future programmers.

In building a model for forming social competence in collaborative e-learning, the following principles were chosen:

- the formation of social skills in the process of completing professional tasks;
- scientific training of specialists in the field of information technology and programming technologies;
- students' awareness and activity.

The organizational and activity block consists of teaching tools and methods that ensure collaborative electronic interaction between students.

In developing the organizational-activity block, we took into account the opinion of O'Neil and Chuang (2008), who consider collaborative learning in a team through the following components: adaptability - setting goals and setting tasks; coordination - organizing group events to achieve timely tasks; decision-making - using available information to make decisions; interpersonal interaction - interaction with other group members; leadership - ensuring group organization; communication - clear and accurate information exchange. Achieving the goal is also divided into components: understanding the content -

possessing knowledge to achieve the goal; problem-solving strategy developed by the participants; self-regulation - motivation (effort and effectiveness) and metaknowledge (self-control and planning).

All these components support the strategy of flexible development methodology - Agile. This methodology is characterized by collaborative work, frequent communication, adaptation to changes, and decision-making in current projects. The Agile methodology represents collaborative interaction based on key values: people and their communication are more important than processes and tools; a working product is more important than comprehensive documentation, collaboration with the client is more important than discussing contract terms; reacting to changes is more important than following a plan as clearly as possible. Working together, communicating frequently, adapting to changes and making decisions in current projects allows for a high level of cooperation based on key humanitarian values: people and their communication are more important than processes and tools; a functioning product is more important than comprehensive documentation, collaboration with the client is more important than discussing contract terms; responding to changes is more important than following a plan as clearly as possible.

It is necessary to highlight the pedagogically appropriate principles of Agile: "use live communication for interaction as the most effective way to convey information in the project"; "flexible processes contribute to the sustainable development of the project, all project participants must be ready to maintain a constant pace of work indefinitely," "the best requirements, architectural and technical solutions appear in self-organizing teams," "the team must systematically analyze the possibilities of improving the effectiveness of teamwork and adjust their work accordingly."

Another attractive (for pedagogy) features of Agile are: visual control with the help of colored cards, signaling the current state of the process; joint work of project participants; constant work on mistakes; daily meetings and organization of work using a sprint - a period of time (two weeks), during which certain tasks need to be completed.

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