DIDACTIC POTENTIAL OF REMOTE CONTESTS IN COMPUTER SCIENCE

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Abstract. A remote contest is a form of extracurricular students' activity. Using the example of "Infoznaika", a remote contest in computer science, the article discovers the didactic potential of such events, which includes monitoring the progress of computer science acquisition, improving the arrangement of extracurricular students' activity, increasing the motivation and cognitive activity in computer science, making interdisciplinary relationships, forming meta-disciplinary competences of junior students and disciplinary competences of middle and senior students.

Keywords: extracurricular activity; remote contest; monitoring; cognitive activity; meta-disciplinary competence; disciplinary competence

Introduction

A global reach of information and communication technologies (ICT) brought crucial changes to the system of education. Namely, remote contests became widespread. However, the didactic potential of such events has not been revealed, and there are no papers on the didactic significance of remote contests

A remote contest is an extracurricular competitive event, in which the participant and organizers can be distantly separated from each other (Belchusov & Sofronova, 2011). The growth of remote contests is based on the requirements to the teachers' assessment and the demand to make a student's portfolio, which includes the certificates and diplomas as results of participation in contests. One of the criteria of the teachers' assessment is the number of students, who have participated in subject Olympiads and contests and who have taken winning places (Markelova, Akhayan & Kizik, 2006). Due to these facts, teachers and students take an active part in various remote contests.

Literature Review

Pedagogical Assumptions

A remote contest is a form of extracurricular students' activity. The analysis of the current literature on pedagogics shows that there are several approaches to the definition of "extracurricular activity (work)". Kodzhaspirova G. and Kodzhaspirov

A. (2005) define the extracurricular activity as an integral part of the educational and nurturing process at school, a form of organization of students' free time. They notice that the directions, forms and methods of extracurricular activity significantly overlaps the supplementary education of children.

N. V. Sofronova specifies that the performance of extracurricular activity in computer science contributes to the development of cognitive interest of students, the advanced study of computer science (in elective courses), the propaedeutic of computer science lessons (in study clubs for junior students), the personal enrichment and making new connections (with the help of communication networks) (Sofronova N., 2004).

Suleimanov R. (2010) classifies the forms of extracurricular activity according to various features, namely the scope and range of students, the time of performance, the systematic nature, the didactic purpose etc. According to the systematic nature, the author defines occasional extracurricular events and regular extracurricular events (which are performed within one academic year at least).

Online Learning

As long as the Internet goes forward, and more and more students obtain their own personal computers, many special contests, which were traditionally held at school and at the regional and federal levels, are now organized remotely. Remote contests have their own specific functions (Bratitsis & Ziannas, 2015). For example, O. N. Volik (2005) defines the following functions, which are of higher priority for a computer creative activity contest as a form of extracurricular students' activity.

An educational function, i.e. a contest, aimed to form an information culture, motivates students to self-education and positive interest to new knowledge. Contestants show the understanding and introduction of facts, concepts, rules, laws and theories of science. Such type of contest as a preparation and presentation of a project allows participants to acquire new knowledge (when they see or hear something new from their rivals) and skills (when they solved a task in the contest). The requirements to the design of contests, the presentation of the project to the judges, rivals and guests, form general educational skills: oral and written communication skills, abstracting, working with printed and electronic media etc. (Marchuk, 2013).

A developmental function means that within the competitive activity a contestant develops in all the directions, such as communication, personal sensory and kinetic capabilities, emotional-volitional and demand-motivational sphere.

A formative function means that within the competitive activity ethical and moral standards of behavior are formed, as well as the sense of the world, managed by information, the ability to follow the rules of behavior in the informational environment and to exercise the laws of this environment. During the competitive activity a student masters the personal demands, the motive of social behavior and activity, values and values-based orientations.

An integrative function means that due to the organizational form, the purposes, the contents, the methods and the means of the contest have the features of systemacity, which is why the contest is perceived as an integral unit of interaction for the subjects of the contest.

A communicative function of the contest means that the communication between the subjects is organized.

An administrative function means that the contest focuses its pedagogically necessary elements (purposes, contents, structure, methods, supporting means) and makes the subjects of the contest form their own information culture.

As for subject Olympiads, Sharapkov A. (2003) and Podlesnyi, D. (2001) define such functions, as motivational, educational, supervisory, representative and adaptational functions.

The motivational function solves the following tasks:

– contributes to the personal self-assertion of students, develops self-respect, forms the drive to achieve results;

– helps the teacher to reveal students' capacities and show these capacities to the students themselves;

– enhances creative thinking and creative approaches in problem solving;

– brings students to the scientific inquiry and its emotional component;

– develops interest and love for the subject;

– motivates knowledge acquisition;

The educational function is implemented due to the following:

– the enhancement of the important feedback between the teacher and the student;

– the upgrading of teachers' professional skills;

The supervisory function allows:

– summarizing and systematizing the performed activity;

– estimating the quality of the educational and nurturing process at school;

– using the results of subject Olympiads for the comparative estimation both of students and teachers.

The representative function defines the reputation of school, city, region, republic etc. In the view of many participants of subject Olympiads, the reputation of the school is one of the motivations to participate.

The adaptational function is not about defining the winners and awarding the achievers but increasing the general culture of the subject and improving the intellectual level of students, fostering self-sufficiency, diligence, drive for competitive activity.

All the above-mentioned functions of remote subject Olympiads and contests are designed to form important personal traits, necessary for responsible life. The experience of a successful performance at subject Olympiads is initially achieved through the participation in them; consequently, we must stimulate a student's wish

to participate at subject Olympiads of a higher level. For this, we must arrange the conditions of the full interaction in such subject Olympiads. The involvement of students into subject Olympiads is one of the components used to create the system of extended knowledge acquisition.

Let us discuss the didactic potential of remote contests using the example of "Infoznaika", an international contest in computer science. The didactic potential here means the possible pedagogical functions, which are not always implemented.

Since 2005, at the initiative of the noncommercial association named "Chuvash Regional Branch of Academy of Information Support for Education" the remote contest computer science "Infoznaika" has been organized for 1 – 11-graders and students of secondary technical schools. Since 2013 the contest has become international. Such countries as Kazakhstan, Moldavia, South Korea, Ukraine, Latvia, Belarus etc. participate in the contest. The remote contest "Infoznaika" is popular enough amount Russian schools. The participants are from all over the Russian Federation.

To implement the remote contest "Infoznaika" there is a portal http://www.infoznaika.ru. For information, the tasks for 2005 – 2017 are uploaded, as well as a part of the contest is written in JavaScript with the possibility to upload the answers and to get the results. A contest logo was developed, which is used in the contest diplomas, certificates, posters and other documentation by the authors.

Research Method

The didactic potential of the remote contest "Infoznaika" is as follows:

– monitoring the educational process of students;
– improvement of extracurricular students' activity;
– increasing the motivation and cognitive activity in computer science;
– setting inter-subject communications during education;
– forming meta-disciplinary competences in junior students;
– forming disciplinary competences in computer science of middle and senior students.

The statistical indicators of solvability of the tasks, detected in the results of the contest, can be considered from the point of view of monitoring the quality of education in computer science at the regional and school level. Since 2016 every student, participating in the contest, can see the results in the profile.

Moreover, the level of formation of universal learning activities in 1 – 6 graders is calculated based on the expertise. School teachers are interested in this information to correct the educational process, to determine the educational level in computer science as compared with other educational institutions, including those beyond the territorial entity.

A teacher can use the tasks of the contest in extracurricular activity. There are tests of previous years on-line and off-line in the site infoznaika.ru. You can also

download the tasks to discuss the salvation in the clubs and elective courses. It is rewarding that teachers highly appreciate the level and the contents of the tasks (see the comments by the participants below):

– We participate in many subject Olympiads and contests, but the tasks of Infoznaika are more professional;
– Thank you, the tasks are very interesting, exciting;
– Interesting, informative tasks;
– The tasks for -11 graders this year are very interesting, keep on;
– The tasks are interesting, there are more tasks this year for the school course, I think;
– The structure of the tasks greatly matches the contents.

Many teachers say that remote contests increase the interest to the subject in students.

Inter-subject communications are revealed in the contents of the tasks. The contents of the tasks in the contest "Infoznaika" are the integration of almost all the school subjects. The main purpose of the tasks is the social adaptation of students in the information society.

Meta-disciplinary competences are defined by the Federal State Educational Standard of Primary General Education (2009); they include universal learning activities (cognitive, regulatory and communicative), providing the acquisition of the basic competences, forming the base of learning skills", and inter-subject notions. The above-mentioned scientists (O. Volik, D. Podlesnyi, A.Sharapkov & al.) proved the inter-subject nature of contests and subject Olympiads. Let us demonstrate that during the organization and performance of the remote contest "Infoznaika" meta-disciplinary competences are formed.

Setting

Let us take the types of the tasks, designed to form regulatory universal learning activities:

1. To decompose the task into the sub-tasks, the interdependence of sub-tasks, to prioritize the sub-tasks and to estimate them;
2. To determine the correct sequence of actions, making the plan drawing up a plan and its recording (including a tabular form), e.g., we plan our work in the editor (graphic, text, database, etc.);
3. Tasks that teach step-by-step and final control over the results, the restoration of missed actions, the identification of erroneous actions, e.g., the task to find and correct errors in the text of the program;
4. To transform information according to the specified rules (coding algorithm);
5. The executives and their management, types of algorithms and forms of their recording;

6. To organize the educational process with an electronic diary, Google Calendar etc.

Among the cognitive universal learning activities, the following types of tasks have been identified:

– general educational universal learning activities:

1. the ability to formalize the results of their activities using information technology;

2. the selection of software products, which solve the task most effectively solving;

3. the selection of computer characteristics and peripheral devices according to the task;

4. the ability to work with reference books, instructions, electronic dictionaries.

– symbolic cognitive universal learning activities:

1. coding;

2. visual forms of presenting information: charts and diagrams, schemes, tables, infographics, graphs, trees, animation, slide shows, their design and study;

3. creation and study of information models: verbal, tabular, graphic;

4. making flowcharts, writing programs.

– logical cognitive universal learning activities:

1. the relationship of objects: compare, find differences, eliminate unnecessary ones; make an order;

2. the classification of objects, the selection of objects falling under the concept;

3. the transformation of information by means of reasoning;

4. the tabular solution of logical tasks.

In the nomenclature of universal learning activities there are two similar sections: cognitive universal learning activities related to the formulation and solution of problems, and regulatory universal learning activities. To give examples of tasks for them, it is necessary to clearly separate these concepts. We assume that regulatory universal learning activities are required when the task has already been assigned to a student by a teacher from outside. In this case, a student only needs to properly organize their work to solving the task, which has already been clearly formulated and correctly set.

The cognitive universal learning activities, associated with the formulation and solution of problems, are necessary for a student in the case when they do some research, as a result of which they face a problem that they must formulate and then find ways to solve it. However, this will already be an unusual task, but an intellectual one. An intellectual task can be understood as a task for which the algorithm for solving the problem is unknown. Such a situation arises in the case of solving non-standard problems. Now we are ready to give the types of tasks designed to form cognitive universal learning activities related to the formulation and solution of problems:

1. solving extra-difficult tasks;
2. solving non-standard tasks;
3. performing research projects;
4. studying the material going beyond the school curriculum;
5. using the elements of the Theory of Inventive Problem Solving.

To form the communicative universal learning activities the following types of tasks can be distinguished:

1. solving riddles, crosswords, rebuses;
2. understanding of the principles the interface construction; working with dialog boxes, setting environment parameters;
3. understanding formal languages, including coding systems and programming languages;
4. electronic record-keeping, creation of textual documents under a template, shared work on documents in the network
5. mastering telecommunications to organize communication with remote interlocutors, asking them for help, etc. (skype, viber, email, translators, social networks and communities, forums, online support services);

The formation of subject competencies in computer science of middle and high school students is carried out in the process of solving tasks by the participants of the contest, since the tasks are made in accordance with the main areas of study of the school course of computer science.

Participants

The experimental check of the didactic effectiveness of the remote contest "Infoznaika" was carried out by comparing the results of the universal learning activities formation among the participants of the competition with students who did not participate in the contests. The experts were computer science teachers of primary classes. In the 10-years experiment the organization of the remote contest "Infoznaika", about 1.5 million 1-11 graders of secondary schools in Russia and foreign countries took part in the contest. An experimental sample was over 200 thousand schoolchildren.

Teachers, whose students take part in the contest "Infoznaika", were invited to act as experts and estimate the level of formation of the regulatory universal learning activities among those who participated in remote contests (experimental group - "E") and those who refused to participate in them (control group – "K"). After averaging-out, the results were summarized in Table 1, from which the level of formation of the regulatory universal learning activities in the experimental group is 38.71% higher.

Table 1. The increase of the formation level of the regulatory universal learning activities in the experimental group as compared with the control group

Element	E	K	Increase in %
goal setting	7.48	5.40	38
Planning	7.31	5.25	39
Prediction	6.91	4.97	38
Control	7.36	5.29	38
Correction	6.98	5.05	34
Estimation	7.45	5.53	45
volitional self-regulation	7.46	5.11	39
Regulatory universal learning activities (overall index)	**7.28**	**5.23**	**38.71**

Let us check the statistical significance of the obtained result by Student's t-test (Sofronova N., 2015) Samples are taken from general populations with a normal distribution. Let us find out whether the statistical dispersion of the samples differ. For this, we apply the Fisher's ratio test (see Table 2).

Table 2.Two-sample Fisher's ratio test for dispersion

Element	Variable 1	Variable 2
Average	7.278571429	5.228571429
Dispersion	0.055914286	0.039547619
Observations	7	7
Df	6	6
F	1.41384708	
P(F<=f) one-tailed	0.342390279	
F critical one-tailed	4.283865714	

As 1.41<4,28, we make a conclusion that the dispersions are not statistically different. Let us calculate the t-test for the similar dispersions (see Table 3).

Table 3. Two-sample t-test with the similar dispersions

Element	Variable 1	Variable 2
Average	7.278571429	5.228571429
Dispersion	0.055914286	0.039547619
Observations	7	7
Pooled variance	0.047730952	
Df	12	

t-statistics	17.5544745	
P(T<=t) one-tailed	3.17881E-10	
t critical one-tailed	1.782287548	
P(T<=t) two-tailed	6.35763E-10	
t critical two-tailed	2.178812827	

As 3.17> 1.78, the sample averages differ significantly at the specified level of significance of 0.05, that is, it is proved that the level of formation of the regulatory universal learning activities among students who participated in the contest "Infoznaika" is higher than among those students who did not participate in the contest.

Next, let us check the formation of cognitive universal learning activities. Teachers, whose students take part in the remote contest "Infoznaika", were invited to become experts and assess the level of formation of the cognitive universal learning activities among those who participated in the remote contests (experimental group - "E") and those who refused to participate in them (control group – "K"). After averaging-put, the results were summarized in Table 4, from which the level of formation of cognitive universal learning activities in the experimental group is 37.25% higher.

Table 4. The increase of the level of the cognitive universal learning activities in the experimental group as compared with the control group

Element	E	K	Increase in %
General educational universal learning activities:			
Independent determination and formulation of a cognitive purpose	7.25	5.20	39
Search and selection of necessary information	7.78	5.55	40
Modeling and model conversion	7.02	5.05	39
Structuring the knowledge	7.16	5.17	38
A conscious and free construction of speech utterance	7.11	5.31	34
Selection of the most effective ways to solve tasks depending on specific conditions	7.30	5.21	40
Reflection of the methods and conditions of action, monitoring and evaluating the process and results of activities	7.18	5.30	35
Notional reading as understanding the purpose of reading and choosing the type of reading depending on the purpose	7.33	5.37	37
Extracting the necessary information from the listened texts of various genres	7.33	5.44	35
Definition of primary and secondary information	7.40	5.45	36
Free orientation and perception of texts of literary, scientific, journalistic and official style	7.08	5.28	34

Understanding and proper estimation of the language of the mass media	7.18	5.43	32
Setting and forming the problem	7.11	5.19	37
Independent creation of activity algorithms for solving problems of a creative and exploratory nature	7.19	5.08	42
Logical universal learning activities:			
Analysis of objects in order to highlight the signs (essential, non-essential)	7.34	5.42	35
Synthesis as the construction of the whole from the parts, including independent completing of the missing components	7.09	5.19	37
Generalization, analogy, comparison, serialization, classification	7.36	5.42	36
Summing up	7.07	5.14	37
Causation	7.14	5.21	37
Making a logical chain of reasoning	7.31	5.28	38
Evidencing	7.04	5.10	38
Making hypotheses and their justification	6.88	4.86	41
Statement and solution of the problem:			
Formulation of the problem	7.02	5.13	37
Independent creation of ways to solve problems of a creative and exploratory nature.	6.96	4.98	40
Cognitive universal learning activities (overall index)			**37.25**

Let us check the statistical significance of the obtained result by Student's t-test (Sofronova N., 2015). Samples are taken from general populations with a normal distribution. Let us find out whether the statistical dispersion of the samples differ. For this, we apply the Fisher's ratio test (see Table 5).

Table 5. Two-sample Fisher's ratio test for dispersion

Element	Variable 1	Variable 2
Average	7.192916667	5.24
Dispersion	0.034560688	0.027756522
Observations	24	24
Df	23	23
F	1.245137584	
P(F<=f) one-tailed	0.301692772	
F critical one-tailed	2.014424842	

As 1.24<2.01, we make a conclusion that the dispersions are not statistically different. Let us calculate the t-test for the similar dispersions (see Table 6).

Table 6. Two-sample t-test with the similar dispersions

Element	Variable 1	Variable 2
Average	7.192916667	5.24
Dispersion	0.034560688	0.027756522
Observations	24	24
Pooled variance	0.031158605	
Df	46	
t-statistics	38.32527956	
P(T<=t) one-tailed	7.39034E-37	
t critical one-tailed	1.678660414	
P(T<=t) two-tailed	1.47807E-36	
t critical two-tailed	2.012895567	

As 7.39> 1.67, the sample averages differ significantly at the specified level of significance of 0.05, that is, it is proved that the level of formation of the cognitive universal learning activities among students who participated in the contest "Infoznaika" is higher than among those students who did not participate in the contest.

Conclusion

The performed study shows that the didactic potential of the remote contest "Infoznaika" is as follows:

– monitoring the progress of mastering the subject;
– arrangement of extracurricular students' activity;
– increasing the motivation and cognitive activity in computer science;
– making interdisciplinary relationships;
– forming meta-disciplinary competences of junior students;
– forming disciplinary competences of middle and senior students.

The comprehensive study of the didactic potential of the remote contest "Infoznaika" was conducted for the first time. Considering the intensive spread of remote contests, it can be argued that remote contests have become a new object of pedagogical research. For ten years, the organizers of the contest have developed more than one and a half thousand tasks, and over 1.5 million schoolchildren took part in the international remote contest "Infoznaika", more than 5 thousand teachers regularly participate in this competition. The organization and holding of distance competitions is a great work of many people, which is important in the process of teaching schoolchildren and which has great didactic importance.

NOTES

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