International Student Online TRIZ (Teoriya Resheniya Izobretatelskikh Zadach) conferences: organizational experience and perspectives

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S2: Educating the Edisons of the 21st Century

CONTEXT The motivation of many students depends very much on the ability to apply their knowledge and skills in practice. An important motivation is the assessment of their achievements by peers, both at home and abroad. The standard format for communication between students and specialists are conferences; however, the participation in international conferences is associated with significant financial costs. There are a lot of extramural conferences, when participants get acquainted with the colleagues' reports only in printed form, but the effectiveness of such conferences isn't high enough. The intramural conferences allow to quickly communicate in a question-answer format, in addition, the emotional component is high.

PURPOSE The purpose of international student online conferences is to develop the students' ability to communicate openly with their peers, not only in native language, but in English, and also to develop the ability to effectively: a) present the scientific results; b) present their ideas, taking into account the infographic requirements, as well as in the public speeches form; c) visualization of their portfolio; d) practical application of knowledge obtained in the study of TRIZ disciplines.

APPROACH "TRIZ technology" conference was organized at the Komsomolsk-on-Amur State Technical University (KnASTU). Students from universities of different countries (Russia, South Korea, China, Japan and so on) participate in it, and these universities must preliminary proceed with an application and conduct testing of communication equipment. The conference was traditionally held in two stages: selection (within each country, in the native language) and international (in English), during which the three best reports on several nominations were selected.

RESULTS The conference is held annually, starting in 2011, and it will be held for the seventh time this year. The number of reports each year is approximately the same – no more than seven reports from each country. The quality of reports, as well as the activity of students, according to experts, are increasing year by year.

CONCLUSIONS Learning motivation of TRIZ disciplines is increasing among students – there is an exchange of experience in the use of TRIZ, not only among students but also among educators. The contingent of the conference participants is expanding, in the direction of reducing and ascending the age and experience of participants, – school children, masters and post-graduate students have been involved.

KEYWORDS International Student Conferences, online, TRIZ

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Introduction

One of the prior tasks of any educational system is training high-skilled professionals for domestic economy, and also the integration of higher educational institutions into the international system of education. Clearly, such an integration is not possible without successful implementation of long range programs of international cooperation. Moreover, these programs can be implemented in different directions - scientific research, innovations and technologies, education, culture, etc.

As a rule, benefits of universities, which actively present themselves on the global stage, are obvious (Sytnikova, 2016):

- profile raising and strengthening;
- achievement of global level competitive ability of results of activity (educational, scientific and research, applied, technical);
- increasing number of enrollment contracts;
- additional university financing, etc.

However, international cooperation of students under university programs is profitable not only for reports quality and financial performance of an institution. It significantly increases the motivation of students for their further professional activity and also is able to increase efficiency of students' work on solving serious tasks doing a course, graduate and post graduate qualification works and making projects.

As for authors' experience, the positive result is caused by several reasons:

- students share experiences and gladly extend their professional perspective (it's one thing to learn facts from literature, but it's totally another to learn it from foreign agemates);
- unavoidable language barrier (the same event can be participated by students from different countries) is a tool for partial elimination of psychological inertness and for deactivation of social stereotypes - students appear to be too busy with communicational issues;
- communication decreases the level of stereotypes of particular persons by means of national stereotypes crossing;
- students get the opportunity to evaluate their level in comparison with international colleagues - draw a conclusion, make an "error correction", choose new vectors of development and personal growth.

What about forms of international cooperation, it can be: international inter-university exchange programs; cooperative research centers; technology parks and incubators; international conferences, symposiums and forums; workshops and colloquiums; internships and off-site educational sessions, etc.

In the paper there is an analysis of the experience of holding international conferences oriented to solving professional tasks by using TRIZ tools.

International problem-project training

Project-oriented learning activity assumes design and creation of an ideal or material innovative product. It is a creative training activity of solving practical task, goals and content of which are defined by students and are achieved by them during the process of theoretical studies and practical implementation under the consultation of an educator or an expert.

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Demonstration of multimedia materials grouped by appropriate subjects can be considered as the mechanism of guiding students' creative activity in a required educational process.

Knowledge gained in the process of project-oriented training is sustained, because different educational subjects interwork each other instead of being learnt separately. Such training model includes working with problems of the real world and practical activities. The project task is to master some particular subject instead of looking for correct answers for educator's questions. Over the project-oriented training students work together with each other during a period of time to prepare a project and present their work for experts after project finishing (Vladimirova, 2011).

As for problem-oriented training, it is a technology of inquiry-based learning. The base of problem-oriented training is the principle when students formulate a practical or theoretical problem. Further revision of the formulation by an educator is possible. Students solve the problem individually or in micro-groups. In this case lessons are formed on the base of inquiry-based learning algorithms. Basing on the problem-oriented training, it is possible to learn a section or the whole educational course (for example, elective or selective course) (Voevodskaya, 2011).

The problem-project approach to the TRIZ tools mastering

Considering the main stages of approaches described above and restrictions imposed by incidental cross-national students' meetings and time for preparing graduate qualification work and (or) master's thesis, we suggest the following stages, which require obligative on-site (live-distant) interaction of all parties of the process - students and educators (including TRIZ experts):

- introductory lecture course on TRIZ basics (1 stage); main goal - formulation of a problem;
- international workshop (2 stage); main goals:
  - specification of task list;
  - generation of fair number of conceptual ideas;
  - elaboration and efficiency comparison of draft projects;
- international forum (3 stage); main goals:
  - technological exchange;
  - acquaintance with new methods and methodologies of solving tasks;
  - development of personal methods;
- international conference (4 stage); main goals:
  - presentation of existing projects;
  - experience exchange;
  - development of new joint directions of the further cooperation.

Figure 1 shows the schedule of events. In brackets, there is an indexing of master students' terms. Arrows show ranges of running events during a term, circles indicate suggested dates of running events.

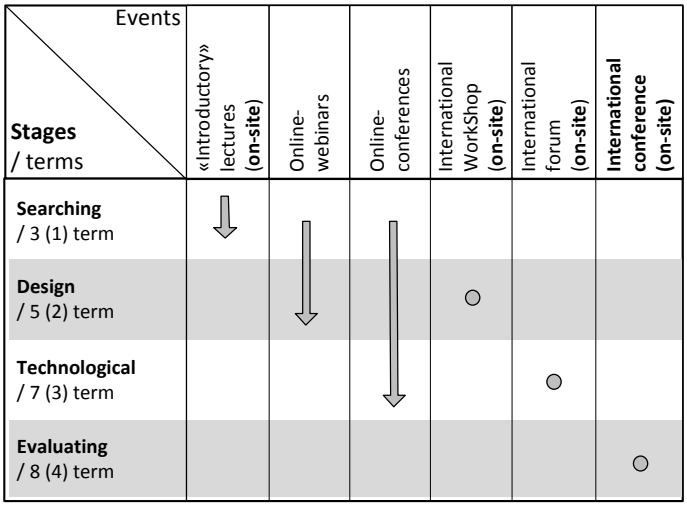

Figure 1: Schedule of events to a term base (Redkolis, Berdonosov, 2017)

At the *stage 1,* students attend a number of introductory lectures. They focus on TRIZ methodology, get acquainted with base tools, reveal a relevant problem and formulate a draft task, the solution of which leads to the problem elimination. During the stage educators' goal is to explain each student theoretical mechanisms, which shall be used in the further work.

At the *stage 2* the following activities are performed: collective interaction with each other with the use of theoretical mechanisms, elaboration of initially formulated tasks, preparation of detailed but still draft project; in the case of positive dynamics rough detailed engineering is possible.

The next *stage 3* is performed in theoretical form. During a forum students learn better from experts than work on their own. They discuss and analyze realization details of ideas and generated solutions. They also take into account experts' proposals and suggestion, but don't work on projects.

At the time of the forum all students proceed to in-depth detailed engineering. They face a rising need of particular tools analysis, exchange of experience and some details appeared during the realization. Notably, the task of students is not only to receive information about new technologies and design procedure, but also to discuss individual questions about their projects with experts, not among themselves (as in the previous stage).

Final *stage 4* is hinged on presentations of developed projects, its' discussions, critical analysis and determination of future research spheres.

As for *online events*, frequency and duration are not beforehand scheduled and are set basing on "student-educator" feedback. For example, if it is necessary to elaborate an issue and discuss a theme (there are comprehension questions), on-line webinar shall be organized. If there are many ideas and it is hard to choose one of them or there are several potential solutions of how achieve some goal and it is necessary to use only one (there are principal issues of project realization), online conference of ideas shall be organized.

By now, the most developed form is international online students' conferences, which will be further discussed.

Technique of organizing the conference

Huge organizational work precedes the conference and comprises the following spheres: software, hardware, informational support, language support, financial support.

From the very beginning, it was suggested that there should be a center (central university), which shall coordinate the whole project. Komsomolsk-on-Amur State Technical University

(KnASTU) became such a center. Besides, initially it was suggested that two or three counties would be involved with the project and then the number of countries would be increased up to 5. Participating countries were selected in accordance with two criteria: minimal lag time as for the center (one-two hours) and the existence of developed educational infrastructure in terms of TRIZ. As KnASTU is located in Khabarovsk region (Russia) and Khabarovsk region is located in UTC+10 timezone, so the following countries meet the first criterion: China (UTC + 8), Philippines (UTC + 8), Malaysia (UTC + 8), Indonesia (UTC + 8), Taiwan (UTC + 8), South Korea (UTC + 9), Japan (UTC + 9), Australia (Melbourne, UTC + 10). Website MATRIZ.org (Yakovenko, 2005) allows considering educational infrastructure in terms of TRIZ in countries selected by the time criterion. There are the following countries: Australia - Royal Melbourne Institute of Technology (Professor Iouri Belski), China - Beijing University of Technology (Professor Guo-hua GAO), Japan - Osaka Gakuin University (Professor Toru Nagakawa), South Korea - Korea Polytechnic University (Professor Yong Won Song), Taiwan - National Tsing Hua University (Professor Sheu). These countries were chosen to participate in the project. For testing period Russia and South Korea were chosen.

Software selection was performed in accordance with the following criteria:

- minimal audio and video data deference, deference of more than 3 seconds is unacceptable;
- connection of up to 10 conference participants (5 countries, 2 university per a country);
- simultaneous transmission of report presentation, voice and video of a reporter, video from conference halls of all participating countries;
- transmission of administrative functions to any participating university;
- ability to record reports and discussions during the conference;
- minimal cost (ideally, free) for client application.

In accordance with considered criteria Russian software TrueConf (Odintsov, 2010) was chosen.

Recommended hardware is shown in figure 2.

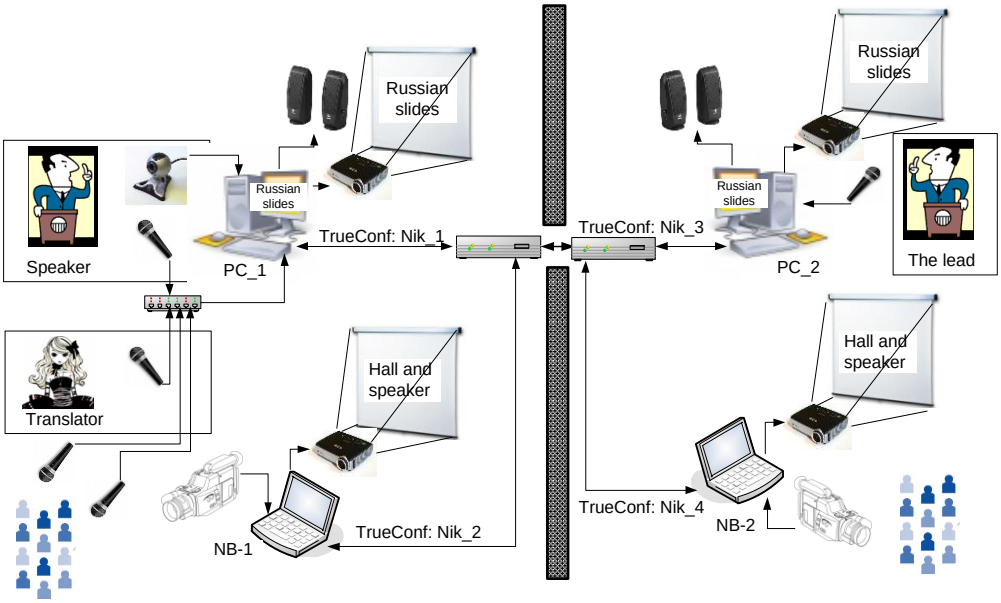

Figure 2: Chart of hardware connection during the conference

Language support. The working language of the conference is English. As a rule, students from different countries are able to read reports in English, interpreters help to translate questions and answers during the discussion.

Financial support. There were financial costs only in 2011, when the central university (KnASTU) bought a license for a TrueConf video conferencing server for 10 users, client application was free. Now, both server and client parts of TrueConf program are free (up to 10 users).

Experience has shown that the most effective solution is to hold two stages of the conference: during the first (national) stage reports are selected to be presented during the second stage. Second stage is international.

Let's proceed to the experience of holding such conferences in the period of 6 years.

Experience of the conferences

Conferences have been held since 2011 up to the present time. Initially, as it was planned, the conference was held between two universities: KnASTU (Russia) and KPU (South Korea), later - between four universities: KnASTU (Russia), Beijing University of Technology, Harbin university of science and technology and Heihe University (China). Then, for two years we returned to the two universities format to solve technical and technological problems and since 2015 we have returned to the four universities format (see table 1).

Table 1: Participating countries per years

Countries and Universities	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Russia. Komsomolsk-on-Amur State Technical University (Komsomolsk-on-Amur)	+	+	+	+	+	+	+
South Korea							
Korea Polytechnic University (Siheung)	+		+	+	+	+	+
Korea Institute of Science and Technology					+		
INHA University in Incheon;					+	+	
Kumoh National Institute of Technology						+	
China							
Beijing University of Technology (Beijing),		+					
Harbin university of science and technology (Harbin),		+					
Heihe University (Heihe)		+					
Taiwan							?

Figure 3: Photographs of conference process: a) screens of participating universities, right to left from top to bottom - KnASTU (Russia), Harbin University of Science and Technology (China), Beijing University of Technology (China), Heihe University (China); b) conference hall - presentation of the report from Beijing University of Technology (left), display with screens of participating universities.

Report categories have varied during the all time, but there always were four of them. Due to extending the range of reporters (see table 4) report categories for pupils (TRIZ for solving everyday problems, TRIZ for solving problems of household appliances) and post graduate students (Usage of the TRIZ evolutionary approach) were added to traditional categories (TRIZ for solving practical production tasks, ARIZ for solving tasks).

Table 2: Evolution of report categories per years

Categories	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
TRIZ for solving practical production tasks	+	+	+	+	+	+
ARIZ for solving tasks	+	+	+	+		+
Application of inventive principles	+	+	+			
TRIZ for non-technical spheres	+	+	+			
Usage of the TRIZ evolutionary approach				+	+	+
TRIZ for solving problems of household appliances					+	+
TRIZ for solving everyday problems					+	
Investment to future				+		

The conference is traditionally held during a day and the number of reports is limited by 14-16 per year. It is interesting how the number of reporters depends on nationality: in Russia there are mostly not more than 2 coreporters (with pupils' participation, this number increases); in South Korea the number of coreporters is traditionally bigger (up to 8).

Table 3: Specification of reports and reporters per years

Countries and Universities	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Average**
Total reports	18	14	14	15	16	13	15
Russia	12	7	6	6	8	6	7.5
South Korea	6	-	8	9	8	7	7.6
China	-	7	-	-	-	-	7
Total number of coreporters	20	28	15	50	43	34	32
Russia min/max	1/2	1/2	1/1	1/4	1/7	1/2	1/3
total	13	9	6	10	23	8	11.5
average	1.08	1.29	1	1.7	2.88	1.14	

South Korea min/max	1/2	-	1/3	2/7	2/3	2/8	1.6/4.6
total	7	-	9	40	20	26	20.4
average	1.17	-	1.12	4.4	2.5	3.71	
China min/max	-	1/4	-	-	-	-	1/4
total	-	19	-	-	-	-	19
average	-	2.7	-	-	-	-	-

Table 4: Evolution of reporters range

Countries and Universities	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Average**
Reporters range							
Russia							
Pupils	-	-	-	4	9	1	4.7
Bachelor students	6	2	4	4	7	5	4.7
Master students	7	7	2	-	5	2	4.6
Post graduate students	-	-	-	2	2	-	2

Projects presented at the conference

Part of the conference reports are the results of finished scientific projects, and some of the reports are the beginning of a project.

For example, the report “ARIZ application to improve efficiency of thermal power plants” is the result of the project of saving cooling tower injector components from icicles which are formed on walls of cooling towers.

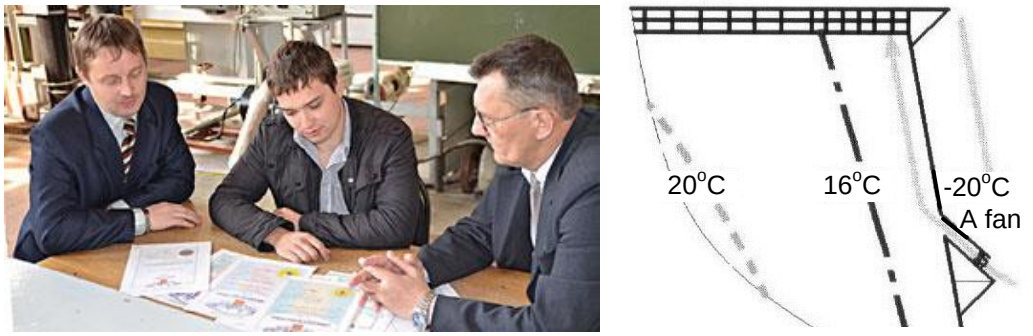

Figure 4: Discussion of application for a patent, part of the figure from the patent showing the main idea.

Another report “Solar collectors for low temperature areas” (2014) was the only beginning of a project and it is planned to start operation of such solar collectors (temperature range up to -50°C) in 2018 and enter a target market in 2019 (Boldyrev, 2017).

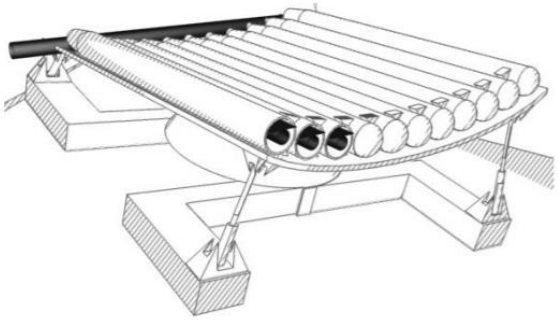

Figure 5: Solar collectors for low temperature areas (Boldyrev, 2017)

Another set of reports is dedicated to analysis of a knowledge field development or TRIZ evolution: “Research of the object-oriented programming mechanisms evolution”, “TRIZ-evolutionary approach as a new educational methodology”, “Research of the object-oriented programming languages evolution”, “TRIZ-evolution of Functional Programming Paradigm”, “Application of TRIZ evolution to analysis of system “Iron”, “Application of TRIZ tools to research social potential of childhood”, “Highlighter life extension”.

To raise public awareness about projects and reports, reports have been published in the conference proceedings since 2015.

Besides, some of researches had been continued during internships in South Korea and Japan.

Conclusions

In general, the method of holding international student on-line TRIZ conferences has shown its efficiency. Sustainable interest in the conference participation is noticed among Russian and South Korean students. Besides, we can see extending reporters range as to the way of youthification (pupils), as to the way of “growing-up” (post graduate students). It is reasonable to broaden the audience of reporters in Australia, China and Japan. In addition, the conference have contributed to deeper learning of TRIZ in universities, which participated in the conference.

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