PROJECT BASED LEARNING AS AN ADVANCED METHOD FOR ISS CREWS TRAINING

S. Klinkov¹, S. Gusev²

¹Moscow University of Economics and Law MFUA (RUSSIAN FEDERATION)
²Moscow University of Finance and Law MFUA (RUSSIAN FEDERATION)

Abstract

One of the main tasks to grant breakthrough science-technology and socioeconomic development of Russian Federation is to get it onboard the top five leading economics of the world, to maintain socioeconomic growth-rate higher than worldwide economic growth-rates saving, at the same time macroeconomic stability is the task to equip the existing economic sectors and the developing ones by the highly skilled cadre. To resolve this task the on-going work has to be oriented to meet the needs in cadres as soon as possible. It elevates the requirements to the existing teaching methods as well as to the advanced methods and practices to train cadres at all levels of the educational system of the Russian Federation; it assumes existence of the attentive and thoughtful attitude in selection of the new, innovative approaches to form the professional competences for cadres of the Russian economy in parallel with the foundation of the talent development pool. Project-Based Learning has proved to be one of the most efficient methods of personnel training in different disciplines. The manned space exploration is one of the technologically advanced areas where the Project-Based Learning demonstrated its potential to be time and investments efficient method of education.

Within this context, it is reasonable to phrase the goal of the article as to review the project-oriented learning being used to train crews to fly into space under the International Space Station Program (ISSP). Crews training to fly them to the ISS are selected as the study object because it represents the synergy of West European, Russian and Asian educational schools. It characterizes the crews training system as oriented towards the integration of different teaching methods under the umbrella of one project carried out and supported by the countries with a different level of engineering-technical and socioeconomic development as well as with a different attitudes in the educational systems when globalization is present in all sectors of international cooperation.

Keywords: to train cadre, project-based learning, globalization, teaching method, ISS crews training.

1 INTRODUCTION

At the present time amount of information on implementation of space flight specialists training programs in the Russian Federation is limited. One of the reasons is that until 2012 selection of candidates was of the so called “confidential” nature, being “sectoral” in essence. The situation changed cardinally in 2012 during the first open selection to the cosmonaut group [5]. This allowed every citizen of the Russian Federation who meets the candidate requirements to become a cosmonaut. Moreover, it provided an opportunity to get access to the system of cosmonaut training that has one unique feature not existing in any other educational system – cosmonaut having completed all stages after graduation qualification examination is admitted to independent operation and control of the object of studies - spacecraft and its onboard systems. Unfortunately, nowadays there are no higher educational institutions specializing in future cosmonaut training. The existing approaches on cosmonauts training have a high potential that can meet the requirements to the future crews who will make the first flights into the deep space. Project-Based Learning.

2 METHODOLOGY

Despite of the fact there are no higher educational institutions in Russia and abroad specializing in future cosmonaut and astronauts training Roscosmos effectively cooperates with Bauman Moscow State Technical University, Moscow Aviation Institute, Faculty of Space Research of Moscow State University to supply personnel for projects of the field [5]. Roscosmos structure has its own organization that is the principal talent pool for Russian and international manned space exploration projects. It is Yuri A. Gagarin State Scientific Research-and-Testing Cosmonaut Training Center Federal State Budgetary Institution [4]. The most famous project in manned spaceflights is a project of...
International Space Station. The experience acquired in course of training of cosmonauts and astronauts for manned flights to International Space Station is unique for number of reasons:

- training has disciplinary not complex approach
- the program is focused on training of the operator able to independently work with the objects of studies immediately upon completion of the graduation qualification test
- continuous training within one project
- training is performed by united team of specialists from different countries
- training is performed at the training bases of the International Partners of the project of International Space Station in compliance with generally recognized standards.

However, prior to discuss a flight to ISS we should understand what training levels the candidate should complete prior to training for crewed flight to ISS. Website of Yuri A. Gagarin State Scientific Research-and-Testing Cosmonaut Training Center Federal State Budgetary Institution determines training of cosmonauts as a number of activities for the purposes of formation and maintenance among the cosmonauts a complex of specific knowledge, skills and abilities required for reliable and safe completion of the spaceflight program and being a basis of the cosmonaut’s qualification [4]. This description shows that category of professional competencies which guides educational programs of the Russian higher educational institutions is not provided in determination of the cosmonaut’s qualification. Period of training to flight has no strict time limits.

According to the First Deputy of the Cosmonaut Training Center, Pilot Cosmonaut, Hero of Russia, Yury Malenchenko, spaceflight training may take up to 15 years [6]. This is a large period of time during which the cosmonaut is regarded as having no flight experience. This means continuous financing of the cosmonaut’s training to maintain the acquired knowledge, skills and abilities without their practical application in terms of spaceflight, performance of which is the main objective of the training process in general. The Project-Based Learning as one of the innovative educational methods in the course of the ISS crews training system in parallel with the exchange of experience of use of other educational methods between specialists of Cosmonaut Training Center and representatives of the education field in the Russian Federation and abroad, contains high potential to reduce period of training for spaceflight in countries of International Partners, that may have a number of positive effects, such as:

- profession rejuvenation
- longer term of service
- formation of high-qualified and great in number candidates pool of professional cosmonauts
- formation in process of training of stable interrelation between knowledge, abilities and skills and their practical significance during the flight program performance
- reduction of budget costs for flight training

At the present time full cycle of flight training includes four stages [4]:

- The first stage is general space training of cosmonaut candidates
- The second stage is training of cosmonauts as per specialization groups and advance training according to types of space crafts (hereinafter referred to as SCs) or specialization fields
- The third stage is training of cosmonauts in approved crews for specific SC flight
- The fourth stage is training of SC crews during the spaceflight.

At that, the first and the second stages are quite flexible in relation to time specified for achievement of the objectives stated prior to the process. The terms may depend both on external factors (existing types of SCs, perspective PCs and availability of information on them, target projects in terms of Russian and international pilot programs etc.), and internal factors that include learning and teaching materials, qualification level of the instructors, and personal qualities of the student. They first of all include his ability to study large amount of material from various spheres (engineering training, training in scientific and applied disciplines, medical and biological training, extravehicular activity training, training for landing in extreme conditions of various climate and geographical zones, psychological and humanitarian training). These two stages are mostly specific for Russian cosmonauts. This is one
of the reasons of attractiveness of training at all the stages with rare application of perspective methods of education.

The third and the fourth training stages during the past 10 years have been closely related to training of international crewed for flights to ISS on Soyuz Russian Transport Spacecrafts. Time factor at these stages is regulated more strictly due to continuous onboard operation on ISS. Many time and quality criteria of training program are the example of joint work of specialists from different countries.

During the whole period of ISS project, continuous work was performed to optimize proportion of time assigned for training to intensify its focus on completion the program tasks without wasting time for onboard training. One of the key tasks of these efforts was a task to reduce time assigned for training at the bases of the International Partners of ISS. One of the important outcomes of solving this task was reduction of financial costs for training, international flights to places of training and accommodation therein, reduction of all types of business trip expenses. In accordance with Order of the Roscosmos State Corporation for Space Activities No. 382 On Approval of Procedure of Determination of Cost Standards for Works of Yuri A. Gagarin State Scientific Research-and-Testing Cosmonaut Training Center Federal State Budgetary Institution [2], standard costs for business expenses of cosmonauts and employees of the center directly participating in cosmonauts’ training in course of training sessions in space agencies of USA, Canada, Europe and Japan (NKOmtpc) are calculated as follows:

\[ N_{\text{cost}} = m \times \left( N_{\text{cost}1} + I + S_{\text{rep}} \right) + s \times \left( N_{\text{cost}2} + I + S_{\text{rep}} \right), \]

where:

- \( N_{\text{cost}1} \) - standard costs for one day of the cosmonaut in a trip in course of training sessions, including daily allowance, accommodation, insurance, car rent costs;

- \( N_{\text{cost}2} \) - standard costs for one day of the cosmonaut in a trip in course of training sessions, including daily allowance, accommodation costs;

- \( S_{\text{rep}} \) - standard costs for flight of the cosmonaut and center employee to the destination and back;

- \( m \) - number of cosmonauts participating in training sessions;

- \( s \) - number of employees of the center participating in training sessions;

- \( I \) - number of trip days.

It is obvious that for implementation of international projects like ISS it is impossible to avoid business trip expenses, but it is worth to study the potential of their reduction. The main indices that affect the amount of saving are variables \((m), (s)\) and \((I)\).

To maintain balance between increase of potential of using innovation approaches in course of training of cosmonauts in opposition to reduction of costs of training in partner states, it is worth to assess costs for advanced training of the employees \((N_{\text{cost}})\), determined in accordance with the contracts concluded (to be concluded) as follows:

\[ N_{\text{cost}} = y \times s, \]

where:

- \( y \) - number of students;

- \( s \) - average cost of training.

And, for example, to assess costs for purchase of specialized software \((N_{\text{cost}})\), that is installed additionally to basic and required for development of materials of teaching aids, creation and keeping of databases, performance of works in terms of training of cosmonauts are determined as follows:

\[ N_{\text{cost}} = k \times C, \]

where:

- \( k \) - number of computers purchased;

- \( C \) - average cost of purchase of specialized software.
And costs for purchase of periodicals (newspapers, magazines) \( N_{\text{TR}} \) are determined on the ground of list of periodicals and applicable subscription costs as follows:

\[
N_{\text{TR}} = k \times C,
\]

where:

- \( k \) – number of periodicals;
- \( C \) – average cost of one periodical.

Comparison of business trip expenses of cosmonauts and employees of the center \( N_{\text{комтрс}} \) with aggregate costs of advanced training of the employees \( N_{\text{обстр}} \), costs for purchase of specialized software \( N_{\text{про}} \), costs for purchase of periodicals (newspapers, magazines) \( N_{\text{TR}} \), shall demonstrate economic effect of investments resulting in rising of staff quality where the Project-based Learning approach drives the need to reduce number of trips to the designated training centers of the International Partners of ISS.

3 RESULTS

The work on these matters is in progress. According to the Head of Yuri A. Gagarin State Scientific Research-and-Testing Cosmonaut Training Center, Honored Research Pilot of the Russian Federation, Hero of Russia Pavel Vlasov [3], a program of perspective development of the center through 2022 was executed, that stipulated application of modern technologies at all stages of training of cosmonauts, and updating of teaching methods. All these endeavors are proved by new approach for organization of scientific activity in Cosmonaut Training Center. Every Department of the Center is scientific research and testing. Scientific Department is regulated by the First Deputy Head of the Center for Organization of Activity and Innovation Development. He actually manages activity of every scientific sub-department, i.e. he is responsible not only for science, but also for application of it. This also contributes to recovery of interrelation of science in the Center with the aerospace processes, increases level of participation of the Center employees in projects related to manned spaceflights. The purpose of these reforms are making of the Center a full-fledged member of the field scientific and research, and research and development works [3].

Therefore, we see that increase of training efficiency though updating of teaching methods, introduction of modern teaching technologies at every stage of teaching are directly related to costs assigned for training and its administrative and logistic support. In other words, it has economic effect.

4 CONCLUSIONS

The described approach of increase of quality of aerospace specialists training in manned spaceflight programs has potential in personnel training in other fields for the purposes of implementation of large national and international projects. It also has potential to decrease financial costs in terms of restricted access to loan assets on the international market. Thus, we ended up with the conclusion that Project-Based Learning is one of the cost effective modern educational methods used in the ISS project to form knowledge, skills and competences of the trainee. Project-Based Learning is worth to be considered by experts communities of other areas. Experience accumulated in the ISS Project to train high level professionals for manned flights to the ISS can become a strong platform to invent new technics to develop required competences for cadre critical for the implementation of May Decrees of the President of the Russian Federation.

REFERENCES

[1] Decree of the President of the Russian Federation No. 204 dated May 7, 2018 On National Goals and Strategic Objectives of the Russian Federation through to 2024, has become effective since May 7, 2018


