

Non-Formal Education: Strategic Resource of Improving Quality of Teaching Mathematics at School and University

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Abstract: Mathematical knowledge is an indispensable element of general culture and it provides a basis for all modern technologies and scientific research. We consider it necessary to enhance non-formal education for solving motivational problems of teaching mathematics. The core of non-formal educational process consists of giving additional stimuli and meanings to performing learning tasks and to envelope the learning cognition into such forms of implementation in order to make them more attractive to the learners and conform to their inner aspirations. Various organizational forms and methods of teaching mathematics on the basis of informational and communicational technologies including seminars, workshops, thematic educational Web-quests, case-method, computer educational business games, etc. serve as the instruments of non-formal mathematical education organization.

Key words: Non-formal education, mathematical education, virtual class, educational web-quest, computer educational business game

INTRODUCTION

Methods of logical reasoning, planning and communication, modeling of the real world, realized and cultivated by mathematics are the necessary elements of general culture with more than three thousand years of history. Mathematics provides a basis for all modern technologies and scientific research and it is an indispensable component of economics, built on knowledge. The creating of modern informational and communicational technologies is primarily mathematical activity. The development of computer programs has made it possible to use all the achievements of applied mathematics in practice and the needs of business and science in their turn have given a stimulus to develop calculus devices, programming and applied mathematics. In these conditions mathematical education should conform to social order of the society as every qualified specialist ought to know mathematical models implemented in their area; they should use them and ideally they should be able to develop new models to meet their professional requirements with the help of corresponding computer programs. The necessity of modernizing methods of teaching arises in connection with the emergence of ‘new students’ a special phenomenon of the 21st century. ‘New students’ are active users of digital technologies and the internet.

Basing on the approaches suggested by the leading pedagogues, it is necessary to synthesize strong points of modern informational technologies for creating a new approach to improve mathematical education. The core of the educational process lies in giving additional stimuli and meanings to performing learning tasks and making learning cognition attractive for the learners and corresponding to their inner aspirations.

We consider it necessary to enhance non-formal education for solving motivational problems of teaching mathematics.

MAIN BODY

In June 2015 Ministry of Education and Science of the Russian Federation suggested for consideration the Concept of the development of continuous education of adults in the Russian Education for the period till 2025 which represents the system of viewpoints on the content, principles and main priorities of the state policy, directed at the provision of opportunities to realize the right of adult population of the Russian Federation to education throughout the whole life (FTPED, 2016).

In the terms of UNESCO the continuous education is defined as formal, non-formal, extra institutional (informal) and thus it is confirmed that education is possible in any organizational form.

Continuous education of adults is implemented by means of:

- Mastering academic syllabi at the institutions providing educational activity (formal education)
- Studying away from the institutions implementing educational activity including education at one's job place (in the form of tutorship, internship, instructing, training, through the realization of various academic syllabi, experience exchange, etc.) and also enlightenment in the framework of the activity of the social and other socially oriented organizations (non-formal education)
- Individual cognitive activity (self-education or informal (spontaneous education) (FTPED, 2016)

Non-formal education is a qualitatively new phenomenon in social and educational practice which has its learning content, based on its unique adequate principles carrying definite functions and solving numerous old tasks in an innovative way. In modern foreign literature devoted to the issues of continuous education, there are such notions as life-long education and life-wide education. The latter means non-formal and informal education as a constituent part of the formal education. Non-formal education means various flexible educational syllabi aimed at the concrete necessities and interests of the learners with the signs of organization, additional quality of the acquired knowledge related to the previously obtained education of a person.

Active integration of modern educational technologies, including open education, electronic education, distant and mobile technologies responds to the growing necessity in renewing the knowledge, skills (competences) and qualifications and their increasing amount.

The system forming quality of the continuous education is the doing component prone to provide the professional readiness of the learners to problem-solving, to the creative transformation of the reality.

The doing component comprises different types of educational activities: research activity, independent research activity, communicative activity, creative activity, etc. The role of corporate education institutions aimed at exchanging the work experience, professional development conferences and seminars is strengthening. The collaboration of higher educational institutions enables the mobility of the students, variability of learning content and the forms of education. The opportunity of mutually choosing the objectives, learning content, the syllabus, forms and methods of educational activity in the training process makes a positive influence on achieving

high cognitive and creative performing levels taking into account balance and harmony between social requirements of personal, professional development and a learner's needs in self-determination, self-development, self-actualization (Sanina and Artyukhina, 2015).

The conjoint activities of the Arzamas Branch of Lobachevsky National Research State University of Nizhny Novgorod (UNN Arzamas branch), the department of physics-mathematics education, of Armavir State Pedagogical University, the department of mathematics, physics and methods of teaching and of the Academy of Social Management, the department of general mathematical and natural science disciplines (Moscow) serve as an example of corporative education.

The instruments of non-formal mathematical education organization include various organizational forms and methods of teaching mathematics on the basis of informational and communicational technologies: seminars, workshops, case-method, computer educational business games, etc.

Let us present a few forms of non-formal mathematical education. Non-formal mathematical education for the schoolchildren is represented by an experimental platform 'Virtual Class'. This project is aimed at developing mathematical skills of the learners and attracting gifted schoolchildren to university by means of using E-learning technologies. 'Virtual Class' represents a community of learners undergoing simultaneous training and cooperating with each other via computer nets.

The following conceptual pedagogical guidelines underpin 'Virtual Class':

- Autonomous cognitive activity is in the centre of the learning process
- Autonomous knowledge acquisition is not passive. On the contrary, from the very beginning a learner is involved into a dynamic cognitive activity which is not limited to gaining knowledge but necessarily envisages its application for solving various problems of the surrounding reality
- Organization of independent (individual or group) work of the learners in a virtual class assumes using innovative pedagogical technologies stimulating the revealing of inner talents of every learner and simultaneously contributing to forming of social qualities of a person

The acquired knowledge and skills, self-evaluation of their own learning achievements, control and correction of the materials that have been learnt are improved during the process of virtual communication. Learning activity is oriented at self correction and mutual correction of the

performed tasks which they get by email. For providing a learner's interest in the process of communication there has been introduced a rating assessment system of learning activity of each participant. It is published on the website and is counted at the end-of-unit final attestation (Sanina *et al.*, 2016; Sanina and Karaulybaev, 2014).

In the project framework there are educational conferences held with the participation of all Virtual Class students supervised by a tutor due to the necessity of communication and systematization of the study material and for the end-of-unit final control. The discussion of learners' reports on study themes is arranged by means of chat rooms, voicemail, instant messaging, etc. depending on the technical capacities of the students. The final control on the study themes is organized in synchronous and asynchronous modes on the account of every learner's rating.

Thematic educational Web-quests are introduced for the organization of non-formal education of the students. Educational Web-quests on mathematics represent informational content defined by the learning theme content, by the objectives and tasks of the final stage of studying and assumes tasks performance using internet-resources. Presently a new internet project named Constructor of Educational Web-quests is being integrated into an educational process. The main objective of using Web-constructors is creating the platform for realization of methods of teaching mathematics by means of educational Web-quests.

Systematic using of thematic educational Web-quests while teaching mathematics enables to solve the following tasks:

- Strengthening motivation of the learners to autonomous learning-cognitive activity at the account of additional motives of the playing, competing, cognitive and other aspects
- Utilization of additional (electronic) educational resources, new types of research cognitive tasks with generalizing and systematizing purposes which activate the research and independent activity of the students
- Imparting to a final stage of the theme learning a new organizational form which is attractive for the students (Aryutkina and Napalkov, 2015)

Computer Educational Business Games (CEBG) should be considered as a component of electronic educational resources which enhance the interactive character of a dialogue between a learner and the learning environment which develops autonomous cognitive activity of the students.

We are going to mark the specifics of CEBG defined by the following states:

- Recreating of a situation and functional links of professional activity in a game computer model; conjoint activity of the game participants playing the roles appointed by the game rules
- Self-development of a computer game situation which previous stage result influences the following stage; the presence of a problem and/or conflict situations;
- The control of the game time (Artjukhina, 2014)
- Combining learning and educational effects through the conformity of the students to the norms of collective actions in a network computer game (4)

Using computer educational business games on various mathematics topics is suggested for the realization of distant forms of teaching. Let us provide an example of a computer educational business game on the theory of sets.

Objective: Studying the Theory of sets.

Tasks:

- Studying the notion of sets, operations with sets, considering the tasks with sets
- Forming the skills to utilize the graphic method while operating with sets
- Developing the skills of formalization while solving problems with the help of the Euler Circles
- Forming informational culture; the need in knowledge acquisition

Conditions: All the tasks are given in an electronic format. The test tasks are performed in on-line mode with the following result. Research and creative projects are defended directly as a classroom activity or sent to the cloud and assessed either by a teacher or other students off-line. The field of a computer educational business game looks like that:

- Final stage
- Practical stage
- Visual stage
- Theoretical stage
- Historical stage

The rules: Students perform the tasks of every stage. After successful fulfilling the tasks they transfer to the next stage.

SUMMARY

The study of non-formal education proves that it does not represent either an alternative or an ordinary addition to the traditional education or moreover extension of traditional education throughout the whole life. It can be stated that formal education prepares and enables the non-formal education and non-formal education in its turn advances personal and professional personality building.

The problem of evaluation of non-formal education is of a priority decision. The absence of clear criteria and indexes showing personal and professional growth of the students represents nowadays one of the obstacles to the integration of non-formal education into the system of continuous mathematical education.

CONCLUSION

Non-formal education represents a qualitatively new phenomenon in social and educational practice. Integration of formal, non-formal and informal mathematical education enables to achieve new educational results (personally valued and professionally significant) and forming of actual competences. The meaningful instruments of non-formal education organization produce the various organizational forms and methods of teaching mathematics on the basis of informational and communicational technologies including seminars, workshops, case-method, computer educational business games, etc.

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