

# Training of Future Technology Teachers: Management Tools and Challenges in Current Educational Process

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Received 27 February 2018 • Revised 5 March 2018 • Accepted 6 March 2018

## ABSTRACT

Technological training is one of the most important components of the system of higher education in all economically developed countries. Objective of this research is revelation of effective management tools in the process of training of future teachers of technology. An experimental three-stage work with 102 students of Kazan Federal University in 2016-2017, directed to determination of level of professional competences formation, was carried out. The analysis of results of questioning and observations showed that the best result in training of teachers of technology is achieved by the tool, based on the use of a combination of means of formal, informal and non-formal education: case methods, business games, master classes, and discussions, participation of students in pedagogical and educational projects of the university. The educational business activity that allows simulating and playing any situation, connected with the organization of a new kind of activity, has to make a methodical basis of training a teacher of technology. The offered techniques can be considered as universal means of improvement of technological education quality.

**Keywords:** integrative science education; training of future technology teachers, formation of professional competences, informal and non-formal education, project-based learning

## INTRODUCTION

For technological modernization, contemporary society needs such experts, who are ready to join carrying out transformations for innovative economy (Bondi & Matthews, 2017). An important role in this process is played by the pedagogical education, focused on formation of such students' competences that will allow them to become not only highly qualified subject teachers, but also to act as mentors and assistants to children, considering individual features of every pupil (Casey & Childs, 2017; Depaep & König, 2018; Lozano et al., 2017; Thomson et al., 2018).

Today in many highly developed countries there are cardinal changes in the system of training of future teachers (Bermus, 2015; Ilyina, 2014; Ozge, 2015; Schleicher, 2011). These processes are often directed to the strengthening of a practice-oriented content of training of students and formation of students' competences, necessary for future pedagogical activity (Jorgensen & Howard, 2005; Korshunova, 2015). In this regard, the main professional educational programs are revised; new profiles of training of future teachers are opened; essential amendments are put in programs of training disciplines and pedagogical practices (Avalos, 2011; Darling-Hammond, 2016; Elliott, 2011; Kalimullin & Gabdulkhakov, 2016).

Technology is a very capacious subject according to its practice and professionally oriented contents. It is focused on either teaching pupils to fulfil labor operations, techniques and elementary actions; or to preparing children for work planning (selection of materials, determination of the sequence of operations, the choice of tools, calculation of prime cost) (Auto & Soobik, 2013). Its main goal is formation of technological culture of a personality. The last acts as a certain criterion of readiness of a school graduate to succeed in the world of professions (Baser, Ozden & Karaarslan, 2017; Chalás, 2014). During technology classes, constructive labor of school students (creation

**Contribution of this paper to the literature**

- Revelation of effective management tools in the process of training of future teachers of technology is presented.
- Main professional competences of future technology teachers are defined.
- Proposed methods of formal, informal and non-formal education, applied in training of teachers of technology, are effective tools, which allow creating graduates' necessary professional competences.

**Table 1.** Number of the students who participated in the research

	Full-time education department		Distant education department	
	women	men	women	men
2nd course	13	1	-	-
3rd course	17	5	10	6
4th course	14	2	16	8
5th course	-	-	6	4

of a product on a creative reformatory basis), defining substantial essence of technological education in general, is organized (Patra, 2016; Sedov, 2016).

Organizationally, the subject "Technology" has to integrate in-class and out-of-class, school and out-of-school informative activities, main and additional, formal and informal education within educational school process (Pichugina, 2017; Reich, 2008). The idea to allocate in educational activity three directions (formal, informal and non-formal) began to be actively discussed after the Lisbon summit had taken place in 2000 (Robertson, de Azevedo & Dale, 2016). Until this time no attention to informal and non-formal education was paid, though formal education without two other forms hardly could be considered as sufficient for successful career and happy human life. Tripon (2014) argue informal and non-formal education have the psychological and pedagogical potential of a personality development, which is incomparable in opportunities.

Due to the increased requirements to personal and professional qualities of a teacher (Meijer et al., 2017), search for additional measures which would allow involving the brightest university graduates in teacher's activity (Gokce, 2014) and increasing appeal of the profession (Beach et al., 2014; Literature Review ..., 2010) is carried out.

So, the objective of our research is to analyse the principles of technology teachers training in the conditions of modernization of pedagogical education; and to provide universal models of the solution of the existing problems.

## METHODS

In 2016-2017, the complex research with participation of future teachers of technology directed to identification of effective instruments of formal, informal and non-formal education was organized and conducted. 52 students of full-time and 50 students of the distant education departments of the faculty of engineering and technology of Elabuga Institute of Kazan Federal University (the Republic of Tatarstan, Russia) participated in the research. In total, 76 girls and 26 young men aged from 19 up to 28 years (from the 2nd to the 5th courses) were invited to take part in the research (Table 1). All participants were informed on the purposes and phases of investigation. No one refused to participate in the activity.

We applied a method of cluster surveys with the subsequent continuous poll (Peña-Ayala, 2014). The number of respondents allows speaking about representativeness of this selection as the group of examinees is uniform.

The research was supposed to include observation, carrying out questioning and conversations with students (individual and group). 12 teachers were involved to the research: 1 professor, 7 associate professors, 3 senior teachers and 1 assistant.

At the first investigation phase, the involved teachers made observations in the groups, studying in full-time education department, in the course of the 1st semester of 2016 during classes. There were made records of changing of students' behavioural activity when using various methods of formal and informal education: discussions, business games, defence of papers and presentations. Level of certain competences formation was being defined in the course of conducting 8 credits and 4 examinations by means of the control and measuring materials, developed by each teacher, participating in the research, for every discipline. Cases, test tasks, control questions and tasks were used as a means of control and measuring materials.

Students of distant education department took part in the research during the sessions which were held in November, 2016 and March-April, 2017. Teachers also defined assessment of level of formation of competences during 4 control classes, 5 credits and 3 examinations.

**Table 2.** Self-assessment of students' level of formation of professional competences in the course of formal, informal and non-formal education

Professional competence	Middle score	Minimum score ( $\pm 0.2^*$ )	Maximum score ( $\pm 0.2$ )
readiness to realize educational programs on the subjects according to requirements of educational standards	7.4	4	9
ability to use modern methods and technologies of training and diagnostics	7.8	6	9
ability to solve problems of education and the spiritual and moral development, trainees in educational and extracurricular activities	8.3	5	10
ability to use opportunities of the educational environment for achievement of personal, metasubject and subject results of training and ensuring quality of teaching and educational process by means of the taught subjects	8.7	7	10
ability to carry out pedagogical maintenance of socialization and professional self-determination of students	8.9	5	10
readiness for interaction with participants of educational process	9.2	7	10
ability to organize cooperation of students, to maintain their activity, initiative and independence, to develop creative abilities	9.4	6	10

**Note:** the values in parentheses indicate the standard deviation

In parallel the teachers, participating in the research, observed students of full-time education within informal and non-formal education: in the course of their participation in various activities and projects of educational and pedagogical character – charity events on production of souvenirs, holding master classes in arts and crafts creativity for children and elderly people, organization of holidays for disabled children, assistance in decoration of class rooms in the children's creativity centers.

At the second investigation phase (first half of the year 2017), questioning of students was held. It assumed answers to the questions concerning assessment by students of level of formation of certain professional competences in the course of informal and non-formal education (participation in extra-curricular actions and projects). The level was supposed to be estimated according to a 10-mark scale. Questions were developed by authors. Irrelevant forms of answers did not appear. The statistical error made 2.1%.

At the third investigation phase (second half of the year 2017), results of questioning were analysed and generalized by means of methods of mathematical statistics; and the prospects of development of technological education were presented.

## RESULTS

During observations, it was revealed that those students, who participate in actions and projects within informal and non-formal education voluntarily, behave more actively during class activities: make reports more often than others, demonstrate higher level of knowledge during the discussions, and willingly undertake a role of moderators during business games and master classes. It was noted by 92% of the teachers involved in the research.

The analysis of answers of students is represented in **Table 2**.

Let us consider what specific tools in management of education of future technology teachers, according to the students and teachers, make effective impact on necessary professional competences formation.

Much attention in the course of training of students is paid to their economic and entrepreneurial training, as a result of which they receive practical skills of starting their own business, of the solution of tasks of the current business activity, of search for the new ideas and resources for business development. The methodical basis of training of the teacher of technology is made by the educational business activity allowing simulating and playing any situation connected with the organization of a new kind of activity including business, credibly imagining all possible consequences of the undertakings. Such activity turns to be productive, as it allows to connect theoretical and practical training, forms and develops the entrepreneurial culture of students (Shatunova & Shabalin, 2014).

Content of entrepreneurial training of future teachers of technology in the Russian higher education institution can be conditionally divided into two blocks (**Figure 1**).

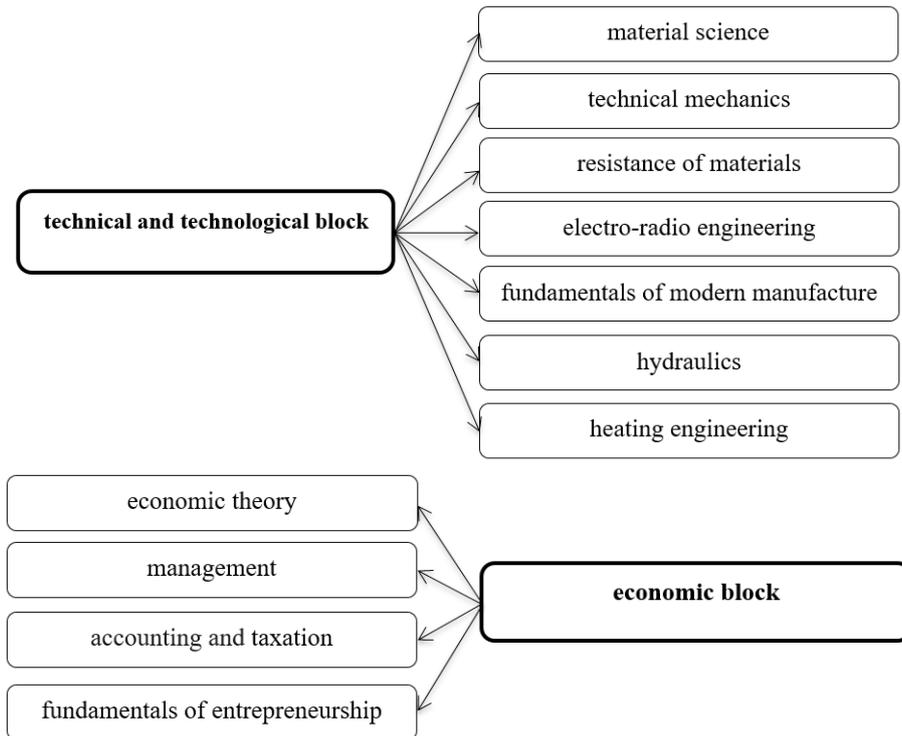


Figure 1. Stages of entrepreneurial training of future teachers of technology



Figure 2. Conducting games on entrepreneurship for senior pupils and students

At the same time, such training has to include a wide range of professional knowledge and practical abilities and also certain qualities of personality.

It should be noted that a very productive form of training of future teachers of technology is organization of unsupervised work of students for development of scenarios and methodical instructions for carrying out studies, games, out-of-class actions for various sections of the subject "Technology". Future teachers work out their skills of teaching activity among their fellow students and junior students. The organization and holding of such actions requires a large number of illustrative means and materials, the electronic presentations, information databases. All this is also developed and made by students. So, at the engineering and technology faculty there are authored business games "Way of a Millionaire", "Steps of Success", "How to Make Business Plan", "My Résumé", etc. These games are successfully held at schools for senior pupils, and for students in educational institutions of secondary professional training (Figure 2). The high effectiveness of these forms of training of teachers was noted by 88% of students participating in the research.

Formation of professional competences of future teachers of technology is promoted also by their participation in interactive workshops, devoted to production of souvenirs. As a rule, work of such workshops is organized within the career counseling activities, held by the university at schools, rest camps for children and youth, at various fairs and festivals. Showing master classes devoted to design and arts and crafts, students, according to

their point of view, do not only show their skills and creative abilities, but also gain experience of educational work (89% of respondents have indicated efficiency of these actions).

As the research had revealed, carrying out master classes in design and arts and crafts creativity with children from rehabilitation centers, orphanages and with elderly people from retirement home turned out to be effective. Receiving experience of communication and work with these categories of the population, allows to create and develop new professional competences at future teachers (100% of teachers and 94% of students have noted efficiency of this form of training).

Discussions, conducted individually and in-group, have shown that students would like not only to participate in holding such actions, they also would like to take part in their development and preparation (84% of students). According to 90% of respondents, work of higher education institution, performed in the direction called "University for Society", is very useful and gives vast experience of communication and cooperation with various categories of the population – from children of preschool age to elderly people.

Results of the conducted research were considered during development of programs for vocational qualification training of teachers of technology. The devised program for advanced training course, focused on development of professional competences of teachers in the field of organization of school pupils' design activity, received positive reviews from audience. Its main advantage became holding a seminar, on which the performance of those colleagues, who have successful experience of implementation of projects, was supposed. At this seminar teachers can learn about the most effective forms of organization of design activity, methods of interaction of pupils with each other and with a teacher that promote development and further implementation of socially important projects.

Particular interest of the audience was arisen by the work forms, connected with creation of small factories on the basis of school workshops with granting job vacancies to physically disabled people; with production of clothes for children with light reflecting elements, which make them visible on the road at night-time; with elaboration and creation of souvenir products for tourists. Expansion of subjects of projects, involvement of all school students in design activity, improvement of its organization becomes a perspective task of teachers of technology.

## DISCUSSION

Organization of training of teachers at advanced training courses provided use of either traditional approaches (lectures, seminars, round tables), or innovative ones (games, discussions, on-the-job training). It is necessary to distinguish a master class from various forms of education. It provides mastering in practice skills of different types of practical activities or certain types of arts and crafts. Master classes are carried out both by teachers of faculty, and school teachers. Students – future teachers of technology are also very often invited to participate in these activities. The international practice shows that the atmosphere, created in these conditions, is characterised by high extent of creativity, as each participant of a master class does not just master technology, but also offers ways of its improvement or modification (Gansle, Noell & Burns, 2012; Howorth, Smith & Parkinson, 2012; Laclea et al., 2015; Long et al., 2012; Sotnik, 2016).

Realization at universities of various initiatives within innovative activity, at which students - future teachers of technology are recruited, can also be considered effective instruments of preparation. In Kazan Federal University, the educational project "Children's University", directed to popularization of scientific knowledge among junior school students, as well as to their intellectual development and expansion of mental outlook, serves as one of such initiatives. The children's university is open for all children, wishing to get acquainted with science. Lectures and practical classes which take place once a month on Sundays, are held by professors and associate professors, with the use of the latest educational technologies. Students of various faculties and the directions of preparation also take an active part in the organization of educational process at the Children's university. Future teachers of technology together with their tutors hold master classes for children in modeling and designing of various products from paper, fabric and other ornamental materials (Figure 3).



**Figure 3.** Master classes for children devoted to modeling and designing of various products

During these classes students gain experience of work with pupils of elementary grades, learn to organize the creative atmosphere in order to motivate children to creative activity, develop and improve their communicative abilities. The important role of this form of training was noted by 100% of teachers and 95% of the students who have participated in our research. It should be noted that, for example, in Japan students of pedagogical higher education institutions undergo similar practice in kindergartens, which present internship platforms for the universities (Suzuki, 2005).

The “Organization of Design Activity of School Students in Subject Area Technology” program became one more project for professional development for teachers of technology. Projects of pupils on technology can and have to become the instrument of achievement not only metasubject, but also subject and also personal results. It should be noted that authors, during drawing up the program, considered experiment of Great Britain on the organization of design training (Rasinen, 2003). Survey of teachers of technology, devoted to the problem of use of a method of projects in their practice, conducted in 2016, revealed the main difficulties, which they face. The problem of shortage of materials is noted by 37% of respondents, the weak material and technical resources as the reason of poor quality of school students’ projects are stated by 42% of teachers, the small number of academic hours, according to 68% of respondents, has also an adverse effect on results of design activity. Unfortunately, only 24% of teachers noted that for solution of the problem of increase in qualitative level of projects on technology they lack knowledge and methodical materials on the organization of design activity. The similar situation is characteristic practically for all Post-Soviet states (Smolentseva, Froumin & Huisman, 2017).

Technology can be regarded as a newcomer in education. Thus, in most Western countries technology education has been developed only in the past two or three decades (Kangas & Seitamaa-Hakkarainen, 2017). There is considerable variation between countries in how this subject is included in the curriculum and used in the classroom (Kelley & Sung, 2017). It is an interesting fact that in Great Britain technology at school, unlike in Russia, is considered the main subject, and the level of technological training of youth allows the state to be in the list of the most advanced countries for a long time. There teachers of technology pay special attention to endow pupils with such qualities which will allow them to become creative, critically thinking, mobile people capable to solve quickly arising problems and to create actual values taking into account individual and public requirements (Rasinen, 2003).

In the American education system the fact that the subject “Technology” is studied from kindergarten has already become a norm and surely assumes integration with other subjects including art. Such form of education is called STEAM (abbreviation from Science, Technology, Engineering, Arts, Mathematics) (Tarnoff, 2011).

In Germany, economy and education system of which, exert a noticeable impact on other states, technological training of youth differs in intensive character and a variety of extra high school programs (Reich, 2008). The dual education system that was accepted there, allows to provide a high level of proficiency of graduates of institutions of professional education, and creates conditions for successful social adaptation of youth (Falyakhov, 2015). All these factors as well as one of the highest level of public financing of the higher education in the world, caused very rapid growth of percent of gifted students who decided to continue their training in Germany, but not in domestic higher education institutions (Chankseliani, 2016; Habibov & Cheung, 2016).

However Russian and the western colleagues are united by the fact that nowadays pedagogical education is considered as a panacea for effective development of the whole education (Centurion, 2016; Valeeva, 2015). So, to improve the whole education system, first of all it is necessary to increase level of training of a teacher (Flores, 2016; König et al., 2017; Valeeva & Gafurov, 2017).

## CONCLUSION

To sum up, this experimental work showed that being involved in practical activities from the 1st course, future teachers start their pedagogical work more consciously. Moreover, they are better prepared for work with various categories of children and teenagers, elderly people; learn their psychological features; are able to use psychological and pedagogical means for this purpose. This fact was pointed to by more than 90% of the interviewed students.

Holding master classes by students, their active participation in pedagogical and educational actions and projects forms such professional competences as: ability to carry out pedagogical accompaniment of socialization and professional self-determination of students; readiness for interaction with participants of educational process; ability to organize cooperation of students, to maintain their activity, initiative and independence. Students' self-assessment of these formed competences made more than 8.9 points on a 10-mark scale (88% of students).

It gives grounds to claim that the offered methods and technologies of formal, informal and non-formal education, applied in training of teachers of technology, are effective tools, which allow creating graduates' necessary professional competences. With that, this research has some limitations. Thus, professional competences of 102 students were determined. Such a small sample can make broad generalization of results difficult. Large-scale control survey is needed to revelation of all the effective management tools in the process of training of future teachers of technology. This is a prerequisite for our further research on the problem.

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