

Career guidance for the prospective students of KNRTU–KAI

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Abstract. The article presents the experience of Kazan National Research Technical University named after A.N. Tupolev—KAI (the former HEI’s name is KAI—Kazan Aviation Institute) in the implementation of the *policy* of career guidance of students and prospective students. The purpose of the article is to share the original KAI practices in the field of career guidance of prospective students, as well as to reveal the essence of the solutions incorporated into the key career guidance activities of the university. Original solutions are described, including: installation of the first supersonic passenger aircraft TU-144 on the territory of the KAI campus; the first scientific-practical conference of young aviators “Aviation of the Future: Trends, Challenges and Opportunities”, dedicated to the 50th anniversary of the first flight of the TU-144 aircraft; creation of an educational complex “Technopolis” for the development of children’s engineering creativity; an online course for schoolchildren during the university’s career guidance campaign “KAI Online School CYBER.TECH”; extended day groups for schoolchildren; the project for the training of new generation of engineers “Wings of Rostec” implemented with the support of the State Corporation Rostec, and some other projects. The factors of entry and retention of personnel in professional communities are identified and systematized, taking into account the professional life cycle of a specialist. It has been identified that in modern conditions, career guidance activities have begun to significantly influence the updating of educational content and modes of study at the university, which is confirmed by the presence of interactive and online KAI events. The university forms and develops an environment favorable for self-determination and self-realization of all participants in the educational process, while covering a variety of target groups.

In the recent past, our country was the undoubted technological leader in the world—they were the first to launch a satellite and a man into space, built the first nuclear power plant and the world’s first supersonic passenger aircraft. Today, domestic enterprises, admittedly, concede leadership in many areas of aerospace science and production to other countries. The restoration of Russia as a world aerospace leader is possible only on condition of advanced training of highly qualified engineering personnel in specialized educational institutions of vocational and higher education.

This problem is solved by the Kazan National Research Technical University named after A.N. Tupolev—KAI (formerly KAI, Kazan Aviation Institute) which is one of the leaders in Russian engineering education. Like any modern Russian university, KAI functions in the context of the growing competition for talented applicants and prospective students. The

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university gives priority attention to the quality of admission. The grade point average of those admitted to the first year is steadily growing: in 2016 GPA was 70.5, and in 2021 GPA was 76.1. In addition, the number of winners and prize-winners of the All-Russian Olympiads entering KAI is rapidly growing. Over the past 5 years, KAI has received 76 winners and prize-winners of the All-Russian and Federal Olympiads, that is the most of all among the universities located in the Republic of Tatarstan.

Nevertheless, it is worth noting that there are serious problems associated with the career guidance of potential applicants entering the engineering bachelor's degree and specialist's degree programs, which also matter for a large number of enterprises of the aviation industry in Russia [1]. These problems include the following:

1. A direct indicator of children's interest in technical occupations is their choice for taking the Unified State Examination in Physics. Unfortunately, the number of school leavers choosing this subject as their final exam remains relatively low. In recent years, there has been a tendency for an increase in the number of school leavers choosing humanities as an elective discipline to pass the Unified State Exam.
2. The quality of knowledge in this subject (Physics) leaves much to be desired: in recent years, the results of the Unified State Exam in Physics are lower than the ones in Social Sciences and Humanities.
3. The following fact is even more alarming. Schoolchildren in Tatarstan and Kazan show the best results in the country in most subjects. Physics, however, is an exception. The results of the average USE score in 2021 in Physics in Tatarstan amounted to 59.39, which is higher than the average in Russia, but far from the highest level among the Russian regions [2].

These problems acute the need to organize effective career guidance and counseling of prospective students based on early identification of their talents. According to the authors, special attention should be paid to the timely identification of the propensity for engineering and technical creativity in children. KAI has got a variety of original practices for implementation of career guidance for prospective students. This experience, according to the authors, can be extremely useful for other universities.

The purpose of the article is to share the original KAI practices in the field of career guidance for prospective students, as well as to reveal the essence of the solutions incorporated into the key career guidance activities of the university.

One of KAI's striking projects in the field of popularization of engineering and high-skills professions among children and youth, their patriotic education based on the greatest achievement of domestic designers is the installation on the KAI campus of the first supersonic passenger aircraft TU-144. The history of the creation of the TU-144 is the history of the great victory of the Soviet Union engineering school, since the design of the aircraft began 2 years later than the British-French Concorde, and the flight took place 2 months earlier. The world's first supersonic passenger aircraft has incorporated hundreds of world-class innovations. The university has carried out a complex operation to transport a 90-ton aircraft to the university campus. At the moment, work has been carried out on the external restoration of the side and its illumination. The plane at the university is the subject of patriotic education, and awakens a sense of pride in the achievements of domestic engineers of the 20th century, and demonstrates the capabilities of human potential.

In 2019, on the basis of KAI, the first scientific-practical conference of young aviators "Aviation of the Future: Trends, Challenges and Opportunities" was held. It was dedicated to the 50th anniversary of the TU-144 first flight, which took place on December 31, 1968 [3].

The main emphasis of the conference was made on the creation of opportunities for an open dialogue between students of aerospace universities and young personnel of aviation enterprises, as well as students of engineering classes at educational schools in Russia. All conference participants had the opportunity to speak at the poster session. The conference was aimed at bright and compelling popularization of engineering education among young people. The key results of the conference were the following: assistance to the patriotic education of children and youth based on one of the brightest symbols of the great Soviet engineering school; increasing the interest of children and youth in the natural sciences and technical creativity; strengthening the international brand awareness of Russian engineering education; emergence of a new tourist symbol in the Volga Federal District and the development of a Russian tourist product based on the TU-144; development of urban infrastructure for children's informative leisure, etc.

Another KAI's initiative in the field of career guidance for prospective students is the "Technopolis" project. The educational complex "Technopolis" is an interactive space that integrates various forms of supplementary education for children in the field of physical and mathematical sciences, engineering and technical creativity. The educational complex creates and implements innovative programs of supplementary education of a technical focus, using modern equipment and education technologies, which contributes to solving the problems of early identification of children's inclinations to engineering creativity. "Technopolis" uses modern digital engagement methods. The main principle of the complex's activity is to show children that engineering area is "cool", to awaken in them the confidence that they can also create a new legend of world engineering.

Both of the above mentioned projects were initially supported by the Russian Presidential Grants Fund.

Long before the start of the pandemic, KAI organized work on the use of online technologies both in the educational process and in the career guidance for prospective students.

We live in an era of digitalization and global access to almost any information through the World Wide Web. The generation of modern children is not called the digital generation for nothing, since from an early age many of them grow and develop in constant interaction with gadgets, social networks, etc. The vast majority of students in modern schools use modern digital technologies in the learning process. Thus, communication channels and interaction formats with prospective students are changing in career guidance of universities.

To expand access to a larger number of prospective students, as well as to increase interest in engineering educational programs at KAI, an online course of KAI Online School CYBER.TECH has been implemented.

The online course for schoolchildren during the university's career guidance campaign the KAI Online School CYBER.TECH allows you to transform a learning mode from "knowledge transfer" into creating conditions under which the processes of professional determination of the schoolchild-applicant become possible.

The aim of the KAI Online School CYBER.TECH is to familiarize the participants with the best fields of study at KNRTU–KAI in order to form a sustainable interest in engineering professions, and to help them choose their future educational trajectory.

The KAI Online School CYBER.TECH creates a favorable environment for enhancing the cognitive activity of the prospective students, and organizes the conditions for the formation of individual educational trajectories.

The results of the online course of CYBER.TECH have become the expansion of the geographical boundaries of the career guidance work of the university and the popularization of engineering fields of study.

An important step of the university in the development of career guidance for prospective students is the involvement of the intellectual potential of students and teaching staff to

prepare and instill an interest in engineering among schoolchildren who are potential prospective students.

One of the most interesting solutions of the university for organizing career guidance for future applicants is the project entitled the “KAI Academy—Mini Wings”. These are online after-school groups for schoolchildren. Within such online groups, KAI’s students provide counseling and intellectual support for schoolchildren for completing their homework. Using online technology, almost any schoolchild in Russia and abroad can receive competent consultations from KAI’s students on various subjects of the school curriculum. The idea of the project is to involve the most talented students in the process of interacting with potential prospective students. As already noted, in KAI there is a fairly high average score of annually enrolled students, by the number of budget places, more than 1,000 applicants become KAI students. Students are a significant intellectual potential of the university. The project “KAI Academy—Mini Wings” provides effective use of this potential for career guidance for future applicants. Due to the fact that students are close enough in age to the schoolchildren being taught, the age barrier is removed, trusting and friendly communication is built, and schoolchildren’ loyalty to engineering and the university is formed. Due to the growing demand, this project has moved from the category of student social design to the category of student social entrepreneurship. The uniqueness of the project lies in the fact that today in the Republic of Tatarstan the “KAI Academy—Mini Wings” as online after-school groups for schoolchildren is the only support center for schoolchildren in completing homework in ten school disciplines. The project develops the entrepreneurial abilities of students based on network forms of organizing intellectual work [4].

Since 2020, KAI has been a member of the “Wings of Rostec” project. The project is aimed at training a new generation of engineers with a set of advanced digital competencies, integrated into the international academic space, fully ready to work in modern conditions at the enterprises of the aircraft industry. The State Corporation Rostec organizes the recruitment of talented prospective students to the aerospace universities of Russia, provides material support for students participating in the project, provides practice-oriented training and subsequent employment at enterprises operating in the management loop of the State Corporation. In addition to KAI, universities from such cities as: Moscow, Samara, Ufa, Ulan-Ude, Perm, Rybinsk, Irkutsk and Novosibirsk take part in the project. The curriculum development is carried out in full compliance with Federal State Educational Standards, and also includes a practice-oriented training modules, for example, Fail-safe, Fatigue Strength, Acoustics, Life Support Systems for Aircraft, Testing of Aviation Equipment, Quality Control, Operation of Aviation Equipment, Industry 4.0, Industrial Design, Additive Technologies, etc.

KAI has a unique creative laboratory—the Glass Processing Science and Technology Center, fitted out with specialized equipment. On the basis of the center, informational activities and master classes are held for schoolchildren and students on the processing of glass waste into ethno-souvenir products. In the future, the issue of using online technologies to ensure the availability of information for everyone is being considered. The Glass Processing Center is the only center for scientific, technical and artistic creativity in the Republic of Tatarstan based on glass processing. The Center’s activities are aimed at preserving historical memory, environmental education, historical education, scientific, technical and artistic creativity of children and youth [5]. The center works with children and adolescents from 12 to 16 years old in Kazan and Tatarstan, who want to engage in technical and artistic creativity in the field of glassmaking, who are interested in the prevention and solution of environmental problems.

KAI has implemented a project to create an interactive exposition “Tupolev Park” on the university campus. The art object is located in the center of the spiral staircase of the five-story building of the German-Russian Institute of Advanced Technologies (GRIAT KAI).

The exposition is a decorative dynamic structure that simulates the takeoff and ascent into the air of aircrafts of the TU family. Volumetric models of the aircraft turbine on the ceiling of the fifth floor and the propeller on the floor of the first floor are connected by thin strong cables, on which exact copies of 15 different aircraft models of the TU family are attached in a vertical spiral. The rotation of the interconnected turbine and propeller sets a smooth movement around the circumference of the aircrafts with the effect of takeoff and landing. Models of 15 aircrafts, which have been created at the design bureau of the world aviation genius Andrey Tupolev, are already in themselves a vivid example of the pinnacle of Russian engineering thought of the twentieth century. All aircraft models have been donated by Tupolev PJSC. Climbing the stairs, now everyone has the opportunity to get acquainted with the history of the creation of aircrafts of the TU family, and learn more about the personality of the legendary designer and manager A.N. Tupolev. A specially developed application through the virtual reality system allows you to study in detail information about the manufacturer, developer, the first flight of the aircraft, as well as about technical specifications (length, height, wingspan, wing area), mass properties and flight data. All this makes it possible to study the history and features of the legendary representatives of the domestic aircraft industry for military and civil purposes in a modern interactive format, for instance, such aircrafts as TU-160, TU-214, TU-22M, TU-330 and TU-204. The project is aimed at the patriotic education of children and youth based on the greatest achievements of domestic aircraft designers. The interactive exposition is an important element of supplementary education and patriotic education programs for schoolchildren and students, as well as an interactive information stand for classes in the framework of project-oriented thematic lessons, workshops, engineering summer schools and other events that take place at the university.

University career guidance activities cover various categories of young people, including children without parental care. So, in 2020, an interesting project was implemented at KAI aimed at developing the abilities for engineering creativity in the children of the orphanage. The KAI team organized and conducted an educational action—a master class for pupils of the Nurlat orphanage located in the Zelenodolsk region of the Republic of Tatarstan. The project was initiated by three organizations working within the structure of KNRTU–KAI: an endowment fund, a trade union organization, a council of university veterans with the support of the Vladimir Potanin charitable foundation. Representatives of the KAI donated to the Nurlat orphanage the means of technical equipment for online learning (web-cameras, headphones, etc.) purchased with the funds of a grant from the Vladimir Potanin Foundation, as well as kits for technical creativity in robotics LEGO Education. The implementation of the project was aimed at solving current problems (technical equipment for online training) and solving promising problems (providing methodological materials, personnel and means for technical creativity). The authors of the project believed that there were many talented children among the inmates of orphanages, including those in the field of engineering. It would be important to organize and conduct events in a timely manner and involve young people in engineering creativity.

An important KAI initiative in the field of career guidance among young people is a project aimed at attracting applicants from specialized vocational education institutions: colleges and technical schools. The fact is that this category of applicants, having already a certain set of competencies and work experience, have significant potential for developing their own abilities, and can achieve fairly high results. Since 2017, KAI has held an annual competition of graduation works of secondary vocational education entitled “Diamonds of Science”. Theses of final qualification works in the form of a presentation have been accepted for the competition. Contest works have been evaluated in the following nominations: Professional Orientation; Scientific Perspective; Best Design; Originality of the Idea. Upon admission to the academic programs of bachelors and specialists, the diploma of the winner

and the certificate of the participant of this competition make it possible to accrue additional points to the results of the Unified State Exam or the results of internal entrance examinations conducted by KNRTU–KAI as an individual achievement. Having the opportunity to take part in this competition increases the awareness of potential applicants about the rules of admission to the university and increases the opportunities for admission to the programs they are interested in.

Thus, in KAI, as in many universities, there are many activities aimed at career guidance for prospective students. Particular attention is paid to the issues of early detection of talents in children, and the development of their ability for engineering creativity. Every year, the set of activities is reviewed, new projects are created and implemented to organize more effective career guidance.

All the above measures for career guidance for prospective students and students have been developed taking into account the identified factors of entry and retention of personnel in professional communities (figure 1).

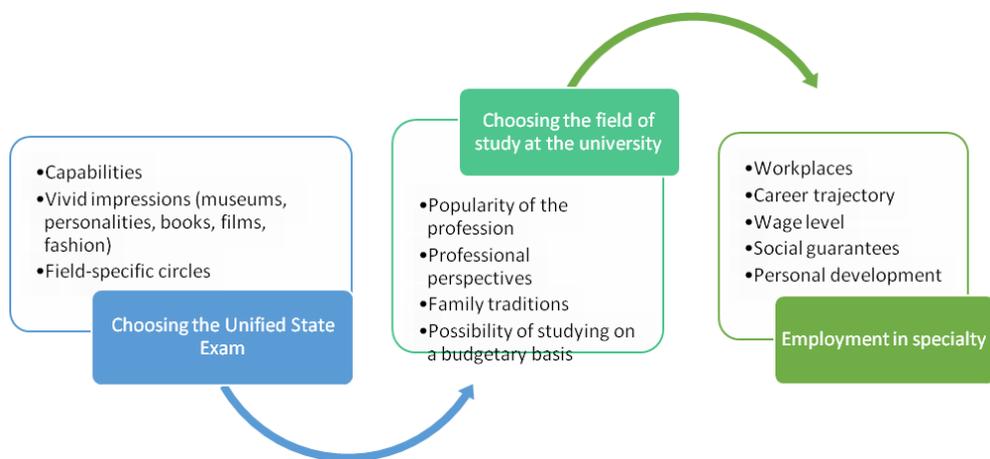


Figure 1. Factors of entry and retention of personnel in professional communities

The authors have identified the following stages: choosing the Unified State Exam, choosing the field of study at the university, obtaining employment in the specialty during the professional life cycle, and the factors corresponding to the stages.

At the stage of choosing the Unified State Exam, according to the authors, such factors as: individual abilities have a significant impact on the possibility of entering professional communities; vivid impressions (museums, personalities, books, films, fashion) received at an early age; the opportunity to visit field-specific circles and sections.

At the stage of choosing the field of study at the university, according to the authors, a significant impact on the possibility of entering and consolidating in professional communities have such factors as: popularity of the profession; professional and financial perspectives; presence of family traditions; possibility of studying on a budgetary basis, etc.

At the stage of employment of a trained specialist, according to the authors, the respective factors are: presence or absence of jobs in the industry; potential career trajectory; wage level; social guarantees; conditions for personal development, etc.

The university proceeds from the fact that during the professional cycle, each person goes through certain stages that have a significant impact on the possibility of entering and consolidating in a certain professional community. According to the authors, one cannot ignore

the fact that, along with the competition between universities for talented prospective students, the competition between the direct fields of study is growing. Taking these factors into account makes it possible to form measures for the career guidance of professional communities' members at various stages of their professional life cycle, and implements educational programs for various age categories of students.

Recently, vocational guidance activities have begun to significantly influence the updating of educational content and modes of study at the university, which is confirmed by the presence of interactive and online KAI events. Any actions are aimed at increasing the integral indicator of the quality of university services [6].

Taking into account the accelerating dynamics of the demand for professional competencies presented by employers and directly by the students themselves, KAI forms and develops an environment favorable for self-determination and self-realization of all participants in the educational process, while covering various target groups of students.

References

- [1] R.R. Anamova, L.V. Bykov, D.A. Kozorez, *Aircraft industry staff retraining as a part of vocational education in the Russian Federation*, TEM J., **8(3)**, 978 (2019)
- [2] A. Svirina, A. Lopatin, J. Titko, *Analysis of students performance in relation to the results of State Unified Exam: The case of Russian university*, Business, Management and Economics Engineering, **19(1)**, 170 (2021)
- [3] A.V. Kornilin, M.F. Safargaliev, *Economic Evaluation of Measures to Improve the Efficiency of Knowledge-Intensive Production in a Networked Economy*, in Proceedings of the 1st All-Russian Scientific-Practical Conference of Young Aviators of Russia "Aviation of the Future: Trends, Challenges and Opportunities", 29–30 November 2019, Kazan, Russia, 411 (2019)
- [4] M.F. Safargaliev, Y.A. Kitsay, E.N. Egorova, L.V. Ermolina, *Modernization of modern entrepreneurship on the basis of artificial intelligence*, Lecture Notes in Networks and Systems, **91**, 346 (2020)
- [5] T.M. Tregubova, V.E. Kozlov, A.S. Kats, *Discourse on students participation in international projects on inter-ethnic tolerance formation in multicultural environment*, Journal of Siberian Federal University. Humanities & Social Sciences, **12(2)**, 261 (2019)
- [6] M. Mironova, L. Nugumanova, A. Bushueva, S. Markova, Z. Zapparova, *Integrated indicator of quality of services of higher education institutions*, in 19th International Multi-disciplinary Scientific GeoConference SGEM 2019, 30 June—6 July, 2019, Bulgaria, **19**, 191 (2019), DOI: 10.5593/sgem2019/5.4/S22.026