



## **Pre-admission education for better adapt freshmen**

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## Introduction

Usually a person passes several levels of education. Transition from one educational level to another is an integral part of youth's life. In Russia there are 3 stages of school education: elementary school (children 7-10 years old), common high school (11-15 years), full high school (16-18 years). Then there are 3 stages of higher education according to the Bologna process: bachelor, master, degree. Each transition is a serious challenge for young persons. Why some of them follow to the next level better than others? The problem of young people's adaptation during the transition from high to higher technical education is analyzed in this article. We describe a new vision of the term "readiness" as a characteristic for successful transition from one educational level to another.

Transition of young persons from high school to university usually involves hard changes for them. But in different countries the changes are not the same. D. Budny <sup>[1]</sup> from Swanson School of Engineering (United States) notes that "The most significant changes come as a part of three major areas of transition: Academic Transitions; Family Transitions; Personal Transitions". Below we shall use this definition and discuss these challenges in Russian educational system. The inability to overcome these challenges leads to the high dropout rate of freshman. D. Budny <sup>[1]</sup> suggests to overcome the difficulties of Family Transitions by making "parents part of the first year orientation and educational process" in spite of the United States' law "Family Equal Rights and Protection Act of 1974 (FERPA)". But the realities of Russian universities are not quite the same, in particularly, concerning the so called "Family Transitions". There is no special law in Russia, but there is a system of parents informing on a student's academic performance (including on-line access) in some universities. Besides, the specifics of large cities in Russia consist in the fact that the majority of university students continue to live in their families. For example, in Moscow about 80% of students live with their parents, and only 20% of them live in campus and meet challenges in the area of "Family Transitions". Nevertheless, we shall show below the significant role of parents in the students' vocational guidance and in their motivation. Examples of overcoming Academic Challenges and Personal Challenges are given in the paper. The positive result consists in the decrease of the number of students' dropouts.

## State of the Art of the Problem of Adapting of Engineering Freshmen

Personal Challenges in transition of a person to the level of higher education are usually caused by the lack of adequate motivation. For example, D. Chubin <sup>[5, 10]</sup> notes that in the United States students show weak interest to math and science. The similar problems are observed in other countries <sup>[6-9]</sup>.

Academic Challenges are associated with insufficient grounding of entrants in STEM complex (Science- Technology-Engineering-Mathematics), and of their difficult adapting to new forms of teaching in a university. As a result, the high level of expulsion of 1-st year students (freshmen) is observed. Authors <sup>[5-8]</sup> note that the increase of dropout rate of students is going on mainly because of their poor progress in math and science.

There are some possible ways to overcome the problem. Authors <sup>[7]</sup> describe the establishing of a special University's center for regular assistance for students in math, but the project failed because of the inertia of students. The same observation we have done at the Moscow

Automobile and Road Construction State Technical University (MADI). G. Kurz <sup>[6]</sup> suggests introduction of additional elementary math course prior to the study of higher mathematics in the first semester or conducting the classes in elementary mathematics along with the study of higher mathematics. But it will require the additional time-consuming for training during university studies to the detriment of the main mathematics course. Besides, it should be taken into account that the students' mathematical skills are heterogeneous and so it is difficult to combine students in the homogeneous groups.

Hence there are positive examples of the implementation of different forms of pre-university training (the Program K-12 and others). Such training allows increase knowledge and skills in mathematics and physics. Our experience has shown that the pre-admission preparation provides more opportunities for training. The forms and models of pre-university training or pre-admission preparation we have described in articles <sup>[11-13]</sup>.

### Introduction of the term "Readiness"

Nowadays the most popular term in the treats on higher education is "competencies". Psychologist R. W. White <sup>[2]</sup> in 1959 defined competency as "capacity to interact effectively with the environment". Now the term is used not only in psychology but also in pedagogy; and one can meet many different definitions and explanations of this term. Thus, from the point of an employer's view "competence" is a combination of practical and theoretical knowledge, cognitive skills, behavior and values used to perform a specific role. Often this is regarded as the required result of higher education. In this case, one should speak about graduates' competencies.

We suppose that the success of studying on any educational level depends on the result of studying on the previous one (insufficient preparation can create Academic Challenges) and on the individual characteristic (Personal Challenges). We suggest defining as "readiness" the personal attribute characterizing ability to make transition from one educational level to another. While introducing the term "readiness" we shall try to avoid a misunderstanding because the same term is used for one of the principles in the theory of learning. There are eight principles: readiness, exercise, effect, primacy, recency, intensity, freedom, and requirement in this theory. In this context readiness is a psychology term that means a degree of concentration and eagerness of a student. It is obvious that a student will study better if s/he is ready to learn not only physically, but also mentally, and emotionally. When we discuss educational aspects, we must take into account both the psychological personality traits, on the one hand and the accumulated knowledge, and the developed skills on the other. So we suggest to understand the "readiness" as a complex characteristic including both the individual's motivation to learn and ability to perceive knowledge and skills of the new level of education above the previous one's. The psychological part of "readiness" is the desire of a person to accomplish and to master skills that is defined as "motivation". There are two types of motivation: intrinsic motivation and extrinsic motivation. The first one is influenced by internal drive for action and goes mostly to psychological subject. The second one is the pressure exerted by the expectations of others; it is under consideration in our investigation. Of course, all the motives are immanent internal properties of an individual; and sometimes it is hard to divide intrinsic and extrinsic motivation. We are interested in the last one because it is a subject to change under surrounding circumstances.

Therefore, "readiness" is broader characteristic than the mentioned above term "competences". We see the advantage of "readiness" term in paying more attention to the psychological traits. It is particularly important when we take into consideration the psychology of children and youth. The common of the "readiness" and "competences" is that they both may be considered at any level of education, but it is possible to measure or evaluate them both after finishing education.

## Methods of investigation

MADI has positive experience of activity of special Pre-University Training Center (PUTC) for improvement of the readiness of senior schoolchildren. The Center is a community of a group of high schools and MADI, and it is based on the bilateral non-profit contracts. Schools involved in the partnership include additional training hours in mathematics and physics in the curriculum of the 10th and 11th grades. MADI staff defines the most important topics in learning programs, helps schoolteachers to overcome difficulties in the program if they occur, and engages university lecturers for trainings. MADI teachers not only train schoolchildren in mathematics and physics but also teach them on elements of engineering. As a result, pupils have both high level of preparation in mathematics and physics and receive qualified vocational counseling that motivates them to enter engineering specialties. We have a long-term investigation of the readiness of freshmen graduated PUTC.

Readiness assessment can recognize it low, medium or high. Triple system of readiness assessment corresponds to the assessment system of examination in Russian higher education: unsatisfactory, satisfactory, good or excellent. We suggest the system of measurement the level of readiness to higher education after graduation high school by assessment of academic results of a first year student (freshman) after two first examination sessions. Unsatisfactory examination result of a student can be the reason of his/her dropout; it means that the level of his/her readiness is “low”. Good or excellent examination assessments correspond to the “high” level of readiness. Other combinations of assessments mean “medium” level. The suggested system may be criticized if it is used for a single person; but its use for groups of students formed according to certain principles has shown its consistency and reliability.

The long-term monitoring of the results of examination sessions was carried out in the purpose to analyze the role of pre-university training in the adaptation of freshmen. In the each year of experiment the whole massive of freshmen was virtually divided into two parts. “Experimental group” (EG) included persons passed the pre-admission training in the PUTC. All other freshmen formed “control group” (CG). The academic results of these groups of students after two examination sessions of the first year of study (in January and in June) were collected and analyzed since 2002. The academic results of students of both groups were compared.

## Results and discussion: Academic Challenges

The results of monitoring of academic assessment of students are summarized in the Table 1. Annually from 1000 to 1200 freshmen enter MADI that conforms the representativeness of the data. The quantitative ratio of EG students from year to year in the whole massive is between 16% - 34%. The column “Without unsatisfactory” shows the percent of freshmen of each group who surely will not be expelled from the university after the end of an examination session. The other column shows the percent of those whose assessments were only “good” & “excellent” (high level of readiness). We add the bar charts (Fig. 1, 2) to provide a visual comparison of the results presented in the Table 1.

The bar chart (Fig. 1) shows that each year students of the “experimental group” received pre-admission training in the PUTC have significantly less “unsatisfactory” assessments than students of the “control group”. For example, in January of 2009/2010 academic year at the end of examination session the quantity of students with “medium” and “high” readiness assessments was about twice more in EG group comparing to CG group (44.7% of CG -students against 85.6% of EG -students without “unsatisfactory” assessment).

The unsatisfactory assessment is a prerequisite for expulsion of the student from the University but the dropout is not compulsory in such a situation. This explains the fact that dropout in EG would not exceed 6.8%, but in CG it could reach 41.7%.

Table 1

Monitoring of the academic results of 1st year students

No	Academic year, month	Without “unsatisfactory” (%)		Only “good” & “excellent” (%)	
		CG	EG	CG	EG
1	2002/03, Jan.	58.3	93.2	18.7	17.7
2	2002/03, June	65.0	92.5	17.4	23.0
3	2003/04, Jan.	55.0	97.9	18.3	30.0
4	2003/04, June	52.7	92.1	15.9	18.4
5	2004/05, Jan.	53.7	96.8	14.9	36.0
6	2004/05, June	56.0	94.1	17.9	24.4
7	2005/06, Jan.	55.7	95.2	16.4	22.6
8	2005/06, June	52.8	92.7	18.9	26.4
9	2006/07, Jan.	65.2	92.3	17.3	17.6
10	2006/07, June	67.1	88.6	20.0	21.5
11	2007/08, Jan.	85.0	94.8	16.6	25.4
12	2007/08, June	54.3	88.2	17.5	21.7
13	2008/09, Jan.	76.5	87.9	16.4	23.1
14	2008/09, June	85.0	79.5	17.5	17.6
15	2009/10, Jan.	44.7	85.6	12.16	22.3
16	2009/10, June	50.6	84.7	13.6	27.8
	W <sub>obt.</sub>	1		18	

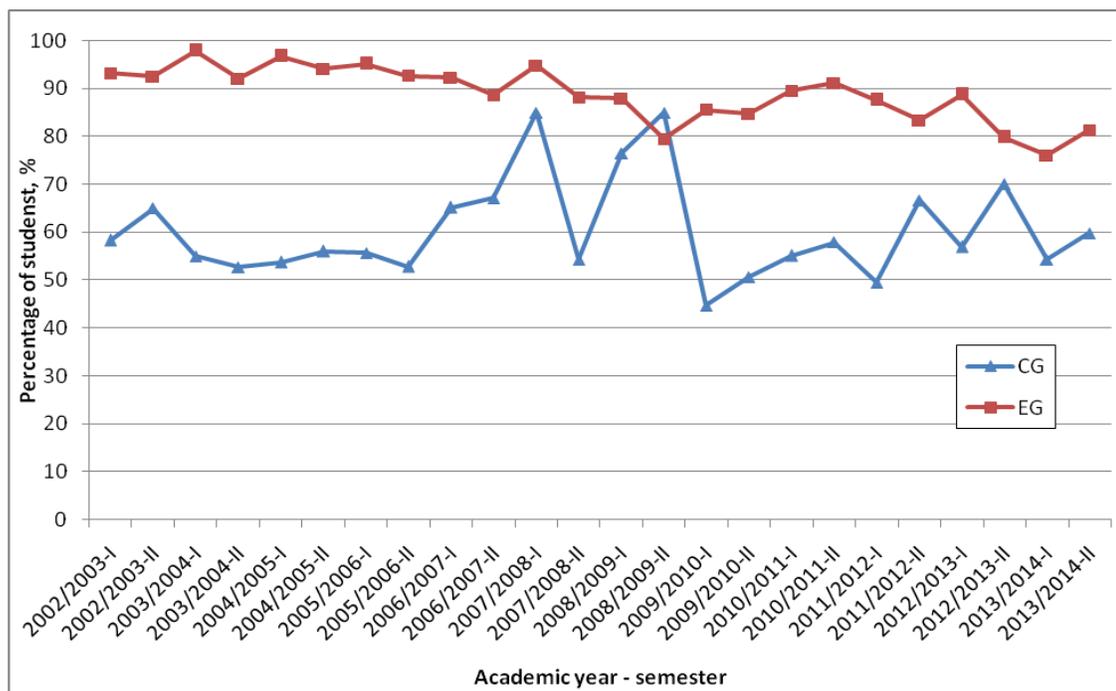


Fig.1. Comparison of the academic results of control group (CG) and experimental group (EG) of 1<sup>st</sup>-year students without “unsatisfactory”, %.

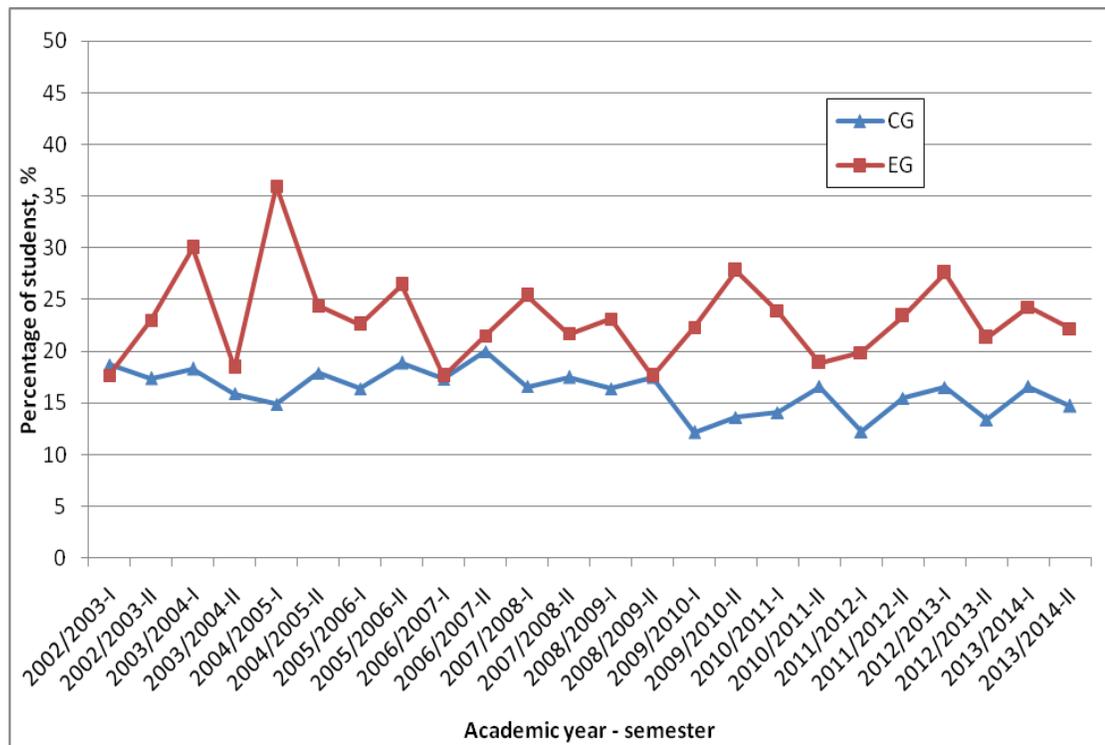


Fig.2. Comparison of the academic results of control group (CG) and experimental group (EG) of 1<sup>st</sup>-year students only “good” & “excellent”, %.

The data in the second paired columns of the Table 1 show the proportion of high-level readiness of students in each group. In some rows of the Table 1 and on the bar chart (Fig. 2) the superiority of EG is not obvious and the difference between CG and EG is minimal. To prove the superiority of EG against CG in the positions “low level” and “high level” of readiness we shall use a test of mathematical statistics. The test is called Wilcoxon/Mann–Whitney (WMW test). Each of paired columns forms two groups of 16 observations (such low number of observations is called “simple case”). It is supposed the null hypothesis  $H_0$  that two populations (CG and EG) are practically the same against an alternative hypothesis  $H_1$  that the population EG tends to have larger values than CG. Below we explain how the  $W_{obt}$  is calculated.

In our “simple case”, it is recommended:

- 1) For each number of the first column to count the quantity of superior numbers in the second column and to summarize these quantities as  $n_1$ ;
- 2) To do the same for the second column; let it be  $n_2$ ;
- 3) To obtain  $W_{obt} = \min(n_1; n_2)$ ;
- 4) To compare the value obtained  $W_{obt}$  with the tabulated critical  $W_{crit}$ . If  $W_{obt} < W_{crit}$  than  $H_0$  is rejected.

In <sup>[14]</sup> we find for 16 observations:  $W_{crit} = 60$  with reliability  $\alpha = 0.005$ . The last row of the Table 1 contains calculated  $W_{obt}$  for each paired columns. We see that  $W_{obt} < W_{crit}$  for the both columns. In this case WMW test recommends rejecting  $H_0$  hypothesis. Therefore the statistical analysis of long-term monitoring (Table 1) shows that the proportion of students who received only excellent and good assessments at the end of the session in the experimental group is higher but the dropout rate is lower.

We carried out similar observations among students of the control and experimental groups during the examinations in the second year. It is observed that the differences between EG and CG became smooth to the second year. This can be explained by two reasons. Firstly, the

majority of students with low readiness were expelled during or after the first year of study. Secondly, students became more adapted to the university system.

All the engineering students before graduating develop a thesis project assessed by the Certification Commission according to the same system: unsatisfactory, satisfactory, good, excellent. Academic results of graduates of CG and EG groups are presented in the Table 2. Without any additional statistical analysis we see that the percentage of “good” & “excellent” assessments in experimental group is higher. So the monitoring of thesis projects’ assessments shows the effectiveness of pre-admission preparation.

Table 2.

Monitoring of thesis projects’ assessments

Month, year of graduating MADI	“good” & “excellent”	
	CG	EG
June 2006	72,7%	97,5%
June 2007	72,8%	91,4%
June 2008	75,9%	96,1%
June 2009	77,4%	95,2%
June 2010	80,9%	94,3%

According to the introduced above terminology the proportion of low readiness in the EG is smaller than in the CG and vice versa the proportion of high readiness in the EG is bigger than in the CG. We suppose that monitoring demonstrates the feasibility of using the term “readiness” because it can be really measured. There is no doubt that the reasons of a better adaptation during the first year are the higher initial preparedness in core disciplines and the better motivation of students who graduated the high schools of PUTC. So the definite response on the Academic Challenges and the Personal Challenges is done. We understand that by using the term “readiness” it is impossible to determine the role of each kind of challenges. But we are sure that the most important kind of motivation that could be done by faculty is to configure the pupils to choose the engineering. But a teacher can’t enhance their concentration and eagerness in a short time. This is a product of a long time upbringing began in the early childhood. The work in the PUTC is planned upon these consumptions.

#### Results and discussion: Personal Challenges

For clarifying the motivation of entrants we tried to find out what had influenced on pupils’ choice of the way to the university during their last years in secondary school. The method of a sociological survey was chosen for investigation. The survey was carried out among university students of the first and second years of study. For the first time it was done in 2006 (about 350 persons were involved). Nine years later, in 2014 we have conducted the 2-nd similar survey (96 students of the first year of study were involved). The results of survey are presented in the Table 3. There were proposed a few answers to choose for some questions in the questionnaire. For some of them interviewee could mention a few of answers. So the sum in the columns of Table 3 is not equal to 100%.

The main question was to clarify the reasons of entering MADI for young people. The proportion of respondents who choose the answer: "I heard a lot about MADI ..." increases slightly. That could be attributed to wider use of the Internet. This assumption is also consistent with the data of a survey (2013) given in <sup>[15]</sup>: 45% of respondents named the university's website

on the Internet as the main source of information. On the other hand almost all teenagers are familiar with Internet but only 45% of them purposefully used it to select a university to study. So we suppose the chosen answer "I heard a lot about MADI ..." shows a lack of willingness and ability to use the search on the Internet.

Table 3

The proportion of respondents (in percentage) selected the answer

The survey question and possible answers to choose from	2006	2014
<b>1. Why did you decide to enter the Moscow Automobile and Road Construction State Technical University (MADI)? (You can choose a few answers)</b>		
1.1 I heard a lot about MADI as a good university with a long tradition;	31	40
1.2 I was advised by parents and friends to do;	49	43
1.3 I like the proposed specialties in MADI.	44	50
<b>2. What caused the choice of specialty where you are studying? (You can choose a few answers)</b>		
2.1. I was advised by parents and friends;	42	32
2.2. Prospects of the future employment opportunities;	61	77
2.3. I like this specialty and it is interesting for me.	49	47
<b>3. What do you expect of further study in MADI? (You can choose a few answers)</b>		
3.1. Acquisition of new knowledge in the chosen specialty;	61	74
3.2. I want to further scientific work;	7	6
3.3. I want get a good job after graduation.	72	76

The percentage of respondents who chose the answer: "I was advised by parents and friends..." dropped. The answers 1.1 and 1.2 shows that the pupils were extrinsic motivated for entering the MADI under the influence of close people. A similar observation was made in <sup>[15]</sup>: 66.9% of the surveyed teachers concern that meeting with parents of applicants is efficient form of vocational guidance. Answer choices "I like the proposed specialties in MADI" or "I like this specialty and it is interesting for me" indicates the intrinsic motivation of the applicant. Growth of the proportion of such responses may indicate the increase of certain autonomy of young people. Answers related to future employment (question "What caused the choice of specialty, where you are studying?" shows the priority of motivation on "Prospects of the future employment opportunities". The question about expectations of study in MADI mainly received answers "I want get a good job after graduation" (the most significant figures in the Table 3!). Moreover, these figures increased from 2006 to 2014. So the young people are increasingly thinking about their future after graduation. In our opinion, it is a positive trend.

## Conclusion

The effectiveness of the pre-admission preparation in the PUTC is shown: graduates of PUTC are more motivated not in the 1<sup>st</sup> or 2<sup>nd</sup> year of study but even 5 years later. The choice made by a pupil of 9<sup>th</sup> grade or by his/her parents to continue training in a school involved in the PUTC is a first step of vocational guidance.

Interviewed during the 2006 - 2014 years young people relate to the same generation. However, the analysis indicates a change of mentality in the past period and allows us to draw conclusions about the trends to improve the effectiveness of vocational guidance. Firstly, the increased interest of applicants and students in being acquainted about future employment. So such information is necessary for them despite the instability of the labor market. Second, investigations showed the significant role of parents of applicants in choosing the university and specialty. So this information about possible employment after graduation as well the information about the difficulties of the transition period "high school - university" should be brought to the attention by the parents.

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