

The first results of experiment in approbation of asynchronous learning process. Mathematics.

K.Arefiev, O.Imas.

Tomsk Polytechnic University
30 Lenin street, Tomsk, 634050
oni@cam.tpu.ru

Abstract

The first results of asynchronous learning process experiment are discussed. The test data of school grounding in mathematics and necessity for a leveling course is analyzed. New form of “algebra and geometry” teaching is discussed. It is concluded the final exam for every discipline has to be accounted equally.

Keywords: educational area, learning process, leveling course

Globalization of European higher educational area requires flexible and uniform of educational programs, common monitoring system of higher education quality. In order to be admitted to Europe Russian higher educational institutions need to correct their educational programs in accordance with universal world standard. In 2003 year by the rector's order there is an experiment in approbation of asynchronous learning process on base of credit system in educational program “Electrotechnica” in TPU.

Program “Electrotechnica” including tow branches “power industry” and “electrical engineering, electromechanics, electrotechnology” is similar to educational program “Electrical Engineering” of leading Europe and American universities. It is different from government educational standard in emphasis of fundamental training (science, mathematics and engineering) and larger share of electives. Rating-credit system elements are approved experimentally: unit of course is credit which indicates the part of the whole educational program, monitoring system was modified and others which were reflected on the first step of experiment not so many. Moreover transfer from traditional linear learning process (study and specialization is defined by curriculum, where the order of disciplines is fixed) to asynchronous learning process (the set of studied disciplines was not defined by year of study but by program requirements). Asynchronous schema lets student to take part in forming his learning path: to choose the quickness of study, order of electives, teachers.

The basis of engineering education quality is fundamental mathematical, physical and chemical knowledge. Between them mathematics is the heart of engineering, being both a language for the

expression of ideas and means of communication results. An effective study program in mathematics for all engineering students is a necessary requirement for the education of qualified engineering graduates capable both of innovation and of adaptation to changing technology.

Higher mathematics department has been providing mathematical disciplines since the first semester of experiment. Mathematical part of program was changed more then others. It was extended from 7% to 12% of the whole program. Three-semester course “Higher Math” was transformed to six courses, each of them is no more then one semester. The teachers, who are the participants of experiment, recasted mathematical disciplines of the first year of study in accordance with new potential and conditions.

In frame of experiment higher mathematics department planned:

- a) to test school grounding in math of the first year of study students (test included items of math that are necessary to success study of higher mathematics disciplines);
- b) on the basis of test results the first year of study students who had insufficient schooling should be sent to study items of school mathematics during a semester (leveling course);
- c) to develop the working program and methodical providing for a leveling course;
- d) to elaborate a necessary methodical providing: electronic manuals, “student package” (a calendar plan, a rating – sheet, sheet of problems and textbooks or manual on the corresponding items of higher mathematics);
- i) to form working group (including the teachers, who developed the disciplines working programs) for developing the finale tests, to carry out writing exam without teachers and to check up student's works. The multi-stage form of the exam had as its object to work through independent expert schema of the learning results.

Higher mathematics department has developed the entrance test and at the beginning of experiment it has tested students. It had a purpose to reveal blanks of knowledge on elementary mathematics at the students who started the first year of study. There were 5 allocated sections: algebra (A), trigonometry (T), exponent and logarithm (EL), geometry (G) and graph of functions (GF). The base of test developing is government educational standard of secondary education and working programs of disciplines requirements. The test format is uniform state examination (USE). There were the testing results on sections, total and USE results in table 1.

Correlation coefficient between total result of testing and USE equals $k = 0.398$, i.e. the results of final school exam rather moderately correspond to

Table 1.

Student	USE max 100	A max 11	T. max 7	EL 8	G max 5	GF max 7	Total max 38	I TA (algebra) max 60
A	75	7	4	3	0	0	14	34
B	66	2	2	3	2	0	9	21
C	71	7	3	6	3	4	23	26
D	88	7	4	4	3	5	23	43
I	83	9	6	6	2	3	26	-
F	79	5	1	0	0	4	10	9
G	90	11	1	5	0	0	17	39
H	81	4	2	4	3	6	19	39
I	47	7	3	2	2	0	14	26
J	71	2	0	1	1	3	7	13
K	71	5	4	2	3	5	19	17
L	88	8	5	7	2	6	28	51
M	56	6	1	2	2	1	12	47
N	88	7	2	0	3	1	13	47
O	88	10	6	6	3	5	30	56
P	-	6	4	3	1	5	19	47
Q	95	8	4	7	2	7	28	13
R	-	1	0	0	0	1	2	21
S	64	9	6	7	4	5	31	-
T	82	1	0	2	0	1	4	-
U	77	7	5	8	2	2	24	43
V	73	7	4	7	2	3	23	34
W	90	11	6	8	4	6	35	51
X	-	7	1	3	2	0	13	13
Y	81	11	5	8	3	4	31	21
Z	50	2	1	1	0	1	5	17
AI	-	4	4	0	2	0	10	17
BI	72	10	3	6	2	1	22	39
CI	67	10	3	6	2	0	21	43

conditions of successful development of mathematical knowledge in university. Only 58 % students have solved 60 % of problems that was the criterion to pass the test. The detail analysis of results on sections allows looking after the elementary mathematics problems of every student. So the test has shown, the weakest parts are a) on trigonometry, б) in plotting of the graph of functions. Thus, on the basis of test results it is possible to recommend or demand for a student to improve the knowledge of the appropriate section. As elementary mathematics is not function of university this work should be carried out after the basic lessons.

Necessity to carry out entrance test and correct elementary mathematics knowledge one can see from the table 1, where there are the results of independent testing in algebra (ITA) in last column.

It was done by independent testing center under TPU for all the first year of study students. One can see from the table students who passed entrance test are successful in algebra. The results of entrance test are well coordinated to results of the algebra test: correlation coefficient is $k_1 = 0.51$, while correlation coefficient between USE results and test on algebra is $k_2 = 0.31$.

Unfortunately, the leveling course has appeared dead. Probably, it is connected with huge amount of organizational problems at first of experiment. We hope expansion of the experiment need to enter the leveling course into educational process for students who have pure schooling in elementary mathematics.

First two weeks of a semester were marked by serious organizational difficulties. Then the holidays had an effect on which lessons have dropped out. As a result lesson hours for algebra were reduced from 48 planned hours to 42. Traditionally teachers settle it along the way. However all students have to have equal possibility and get knowledge and skills equally. On the other hand students have not pay for non services rendered. It must be corrected. For example: the official date of a semester closing can be moved on those days, which have appeared celebratory in the current half-year. So in the end of a semester should appear additional «Thursday» and «Friday», if the holidays have dropped out on them.

Recasting mathematical part of educational program and making it in accordance with world standard we have returned to tradition to study higher mathematics by separate parts: “algebra and geometry”, “differential calculus”, “integral calculus”, “differential equations”, “complex calculus” (necessary for all specialties), “operational calculus”, “methods of mathematical physics”, “probability and statistics” etc. (advanced discipline, which are chosen for a concrete specialty). In a combination with new appraisal plan, the student has greater responsibility for studied discipline. Here every studied discipline is estimated on a 10-ball scale. At the end of every semester average grade of student is defined on the results of his study (60% - work in a semester, 40% - the session) by the formula

$$C = \frac{\sum_{i=1}^N c_i p_i}{\sum_{i=1}^N p_i}$$

where c_i is numerical value of grade, which corresponds the final attestation of student in semester in i^{th} discipline, p_i are its credit; the number of terms equals all N disciplines, on which

student was registered during of his study. In accordance with it the student receives the appropriate encouragements or privileges in compliance with the current legislation, charter and orders of TPU. If the result of attestation is not satisfied (average grade is less then 3) the student should repeat study of discipline (if it is obligatory). If the student is repeatedly registered on the same discipline, both records are kept in the documents, and both grades participate in account of an average grade. Thus, the student is not deducted from among the students, even if he has fouled discipline. But he is extremely not interested in reception of low grades as it will lower his average grade and can be reflected at a choice of a prestigious specialty.

The department has to provide discipline in any semester (to give the teachers and methodical providing) if the number of students is enough for opening it. Short separate discipline of higher mathematics allows the teacher to do methodical work more qualitative and more requires his responsibility for student's knowledge.

Within the framework of experiment new way of "algebra and geometry" teaching was realized. It was like seminars. Certainly, the lecture component was present but it was optimized specially under every concrete group of students. Besides it has allowed a significant part of a program material to charge to study independently, to check and to work originated questions. Despite of the unforesee reduction of lessons hours students have shown the second (average - 31) result of independent testing on algebra after the students of the faculty of automatics and computer engineering FACE (average - 34). It is necessary to note that among all faculties of TPU there is the separate course of "algebra and geometry" for FACE only. The others learn "algebra and geometry" as a chapter of higher mathematics. Just on the base of it one can make a conclusion «seminar» way justifies itself.

"The package of the student" was left unsolved. Unfortunately, the electronic manuals «algebra», «geometry», «introduction in calculus», developed by the teachers, have not reached the students. Neither scientific library nor computer classes of faculty could not set the electronic manuals and to give access student to them during a semester. Resource of higher mathematics department (8 computers) was not enough. Moreover, as the experiment has started in two weeks after the beginning of a semester, students could not take the textbooks recommended by teachers. Then practice has shown that experience of foreign languages teachers (to change the textbooks by copies) was found inapplicable: a) the harmony, continuity is lost, and, hence, logic of a statement of the textbook is lost also, б) an expense to prepare x-copies has

appeared not less then to buy or to edit the textbook.

In general last step of experiment, session, was finished satisfactorily for mathematical disciplines. The deviation from the plan was observed that all work to prepare the tickets, be present on the examination and check of the students works was done by the teachers providing disciplines. And if for "differential calculus" final exam has passed by the plan (at the nominated day, once, the examination was organized and is carried out by faculty, the finale work at the "linear algebra and analytical geometry" was carried out without any attention from the faculty. At the result it was carried out 6 times (with organization problems). The reason it sees in the traditional name of final works: "examination" is in the first case, "offset" is in the second. It has resulted to status falling of final work on algebra both by eyes of the students and by eyes of faculty. There was not planned any day for preparation the "offset".

In tradition of Russian educational institutes "offset" has not quantitative expression, knowledge is graded by qualitative level only: yeas or no. However, as it was discussed above, the new system of grades requires the responsibility for every studied course, because of influence on the average grade. In this context the names «exam» and "offset" lose meaning. The high credit disciplines get the important status. However every discipline should have equal "rights" in examination session from foreign language to mathematics.

Thus, one can make the first conclusions about results of organizational benefits and study of mathematics within the framework of experiment.

1. The formation of the mathematical part of program by separate semester disciplines requires larger responsibility both on a student and on a teacher.
2. Pure elementary mathematical schooling and necessity for a leveling course was confirmed again.
3. Inadmissible is to reduce or increase lessons hours during a working semester. It breaks the working program, disorients the student and destroys methodical work of a teacher, which was done preparing the discipline.
4. The session and final exam organization is thought insufficiently. There should not be a difference in responsibility for a studied course, even if the final work is called as "offset" or "exam".
5. We can not approbate the independent expert commission work making final tests in the first semester. However the teachers find organization form and results of exam on "differential calculus" satisfactory.

6. Consultations for the students were not thought over in any way. In frameworks of asynchronous experiment, when the student group does not exist as such, traditional weekly meetings with a teacher have appeared insufficient. As a result they have been required 6 hours per a week. As the teachers have not their office, consultations looked like additional but no charge job.

7. In process of experiment some program and curriculum defects are opened. So basic discipline "Integrated calculus" was found shorter then advanced one "methods of mathematical physics", but "methods of mathematical physics" was turned unclaimed by faculty.

We hope that the first experience and opened mistakes will not be left without attention on the part of faculty and all wishes of mathematics teachers will be taken into account.