

**Definition of development level of communicative features of mathematical speech of bilingual students**

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**Abstract.** Lingual environment of Republic of Tatarstan (Russian Federation) is bilingual. Pupils in schools are being taught on two languages: Russia and Tatar. Some graduates of schools of Republic of Tatarstan study in the institutions of high education on bilingual base. The aim of research is to develop and apply definition criteria of development level of basic communicative features of mathematical speech of bilingual students.

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**Introduction**

Years of global reformations that have been going on in Russian since the end of XX century caused maturing of multilingual system in the Republic of Tatarstan that may be seen in using Tatar and other languages in official and informal communication. About 82% of Tatarstan youth has acknowledged the necessity of having fluent Russian and Tatar [1].

Graduate student in Tatarstan may study in two languages. For example on the capital of Tatarstan the city of Kazan the following high education institutions provide the possibility to study on bilingual basis: Kazan Federal University, Kazan State Architecture and Civil University, Kazan National University of Research and Technology. But each institution of high education realizes its own model of bilingual education due to specifics of professional education and the lack of state governing in the sphere of bilingual high education.

Paradoxical situation has developed in the Republic of Tatarstan. On the one hand, students that had been studying mathematics in school in Tatar language are obliged to pass USE (united state examination results of which is accounted for putting in the list of students) in Russian like all the graduates of Russian schools. On the other hand, after entering high educational institution many students choose Tatar language as the language of education. As a result in one group there may study students with principally different level of knowledge of Tatar language. Trainers have a pedagogical problem of selection of the strategy of bilingual education.

Mathematics is the discipline of research in our work because it is the base of professional engineering education. Knowledge of mathematic terminology and the capability of logic thinking as

well as the capability to conduct proving are necessary conditions of mastering engineering disciplines.

Theoretical base of our research is being formed of the works of Russia scientists B.V. Gnedenko, J. Ikramov, A.A. Stolyar, A.Ya. Khinchina [2]. They have analyzed speech development in the process of mathematic studying in tight connections with development of the culture of thinking. We have also relied of the works of foreign scientists Ellerton [3], Clarkson [4], Austin и Howson [5], R. Barwell, J. Moschkovich, S. Staats [6] covering the study of the role of language in study mathematics. They analyze the conception “academic language” in mathematics, study the so called “hybrid language” used by mathematicians for communicating mathematical ideas to mass reader. According to Cummins [7, 8] bilingual students are better in mathematics if they speak both languages of education relatively well. It is proved by the works of Clarkson [4], Clarkson & Dawe [9], Moschkovich [10], Secada [11], Setati [12]. Some scientists propose certain methods, for example, Salekhova L.L. and Tuktamyshev N.K. Use speech-thought tasks for development of mathematical speech on the second language [13].

The difficulty lies in defining characteristics of “mathematically structured language” of a student. Listed researches do not give definition of this conception and do not work out criteria and indicators of its development.

**Method**

Let us introduce basic criteria of “mathematically structured language” of students: correctness, accuracy and logic basing on the fact that the language manifests itself in speech. It is the least set of communicative qualities that in general allows making conclusions about the level of definition of a certain type of speech [14]. Correctness of speech

means correct using, pronouncing and spelling of mathematical terms, symbols and notations typical that are words and expressions typical for the language of mathematics. Accuracy is characterized by the choice of lingual means that optimally express the meaning of statement and reveal the main idea of it. It is also expressed by capability to clearly, precisely and fully express the idea both in writing and orally, in accurate and optimal recording, drawings and figures, optimal distribution of graphic material in text. Logic is expressed by capability to clearly express logic structure of sentences orally and in writing, in clear connection of sentences in mathematical reasoning, in logic and consistence presentation of material, in capability to construct the text regarding its semantic structure.

Empirical material has been gathered in the process of education in high mathematic in Tatar language of 18 students of civil faculty of Kazan State Architecture and Civil University of the Republic of Tatarstan. At the beginning of research students were asked to answer the question what language they thought on solving mathematical tasks formulated in Tatar. 12 people answered that they thought on their

native Tatar language and 4 students answered that they thought in Russian and then formulate the statement in Tatar language. 2 students answered that they thought both in Tatar and Russian depending on situation. This sample of students was divided into three subgroups basing in criteria of considering speech as the way to form and to formulate the statement by first and second language (see Table 1).

First subgroup T was comprised of students that graduated from Tatar schools and grammar schools and have been studied monolingually in native Tatar language for 11 years. Subgroup R was comprised of students Tatars that studied mathematics in secondary school and in basic school in Russian. Bilingual students of subgroup B had been studied before 10<sup>th</sup> grade in Tatar and in 10-11 grades in Russian.

Texts written by students are materials available for observation so students' written works, oral answers of students, remarks in the dialog with trainer were the object of research. 3 level scale of scores (High – h, Medium –m, Low-l) was used in research.

**Table 1. Results of development of mathematical speech qualities of students**

Subgroup	Characteristic	Number of persons
1 (T)	Development and stipulation of thought in the first language (Tatar) with further translation into second language (Russian)	12
2 (R)	Development of thought in the first (Russian) language and stipulation of it in second language (Tatar)	4
3 (B)	Development and stipulation of thought in the second language	2

### Main body

To check accuracy of mathematical speech students were asked to give definition of parallelogram, square, derivative of function in a point in Tatar as well as provide solving of a task in geometry in writing with explanations and comments to each stage of solution. For results of analysis of written works of students' revealing accuracy to mathematical speech see Table 2.

**Table 2. Accuracy of mathematical speech of students**

Level	Subgroup B	Subgroup P	Subgroup T
H	12.5%	12.5%	41.7%
M	62.5%	37.5%	35.4%
L	25%	50%	22.9%

To evaluate logic of mathematical speech of students they were asked to solve tasks in Tatar language focused on operation with verbal and logic structures of mathematical language. Students were asked to give definitions of scalar and vector products

and make elementary conclusions from known theorems. For results of evaluation of logic of mathematical speech see table 3.

**Table 3. Results of evaluation of logic of mathematical speech of students**

Level	Subgroup B	Subgroup P	Subgroup T
H	0%	0%	50%
M	100%	40%	33%
L	0%	60%	17%

Basing on the data we may conclude that logic of mathematical speech in native language of students using non-native language in studying mathematics is lower.

To check lingual component of correctness of mathematical speech students were asked to write terminological dictation in Tatar language. They were supposed to write down and explain in writing in Tatar language 8 terms that were dictated to them. Correctness of speech was also evaluated by the way of analysis of written works with solving of

mathematical task. For results of definition of correctness of mathematical speech see table 4.

**Table 4. Results of definition of correctness of mathematical speech of students**

Level	Subgroup B	Subgroup P	Subgroup T
H	50%	0%	41.1%
M	50%	0%	33.9%
L	0%	100%	25%

Having calculated expectation value of aggregate of results for each of subgroups we obtained the following results:  $M(T)=0,74$ ,  $M(B)=0,71$ ,  $M(R)=0,45$ . As expectation values of subgroups B and T are close it may be concluded that change of the language of education did not affect development of basic communicative features of mathematical speech to bilingual students.

### Conclusion

We have provided definition criteria for basic characteristics of “mathematically structured speech” of a student: correctness, accuracy and logic. It is basic set of communicative features that allows evaluating the level of development of this type of speech by its total. We have developed tests and using them defined the level of development of basic communicative features of mathematical speech of 1<sup>st</sup> grade students of technical university studying mathematics in Tatar language.

### Resume

Basing on the results of research we may presume that changing of the language of education leads to decrease of basic communicative features of mathematical speech of majority of students. Level of development of logic and correctness of mathematical speech of bilingual students of subgroup R who were taught in primary school (1<sup>st</sup>-4<sup>th</sup> grades) only in Tatar language and in secondary school in Russian is significantly lower than those of the other subgroups.

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