On Teaching Mathematics to Philology

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Abstract: The relevance of the problem stated in the article is predetermined by the fact that at present the subject "Mathematics" is studied practically at all university departments, including humanitarian ones, and consequently the task of motivating students to study non-core discipline arises inevitably. The aim of the research is to show the necessity of studying mathematical and historical-mathematical disciplines by students of philological directions for improving their special training and forming an ability to comprehend literary metaphors based on the facts from natural and exact sciences. The leading approach to the study of the problem is generalization of experience of the teachers of Elabuga Institute of Kazan Federal University on teaching mathematical subjects to students of humanitarian faculties. Evaluation of the effectiveness of teaching mathematical disciplines was carried out by means of questioning students of different courses and training directions whether they recognize the quotes from the poetic works of Joseph Brodsky without indicating the authorship, as well as the analysis of the content of educational curricula in these disciplines. The research allowed the authors to draw conclusions about the incorrect interpretation of the relevant fragments of literary works by the majority of students of the philological direction of training, which is a consequence of the narrowness of outlook, lack of knowledge even of the well-known facts from the history of mathematics and natural sciences. The study proves that mathematical profile students demonstrate a more exact comprehension of the author's ideas, though they do not understand the proposed citations fully. The study revealed that the training of highly qualified specialists in Philology should be more versatile in order to expand not only the students' literary horizons, but provide them with knowledge of natural sciences. The authors developed recommendations on the content of curricula in mathematical subjects for Philology students.

Keywords: *teaching mathematics, motivation of students, Brodsky's poetry, Lobachevsky's discovery, humanitarian education.*

I. INTRODUCTION

It is no secret that in modern conditions, a specialist working in the field of education has to deal with a large amount of information. Proper processing of this information and making the right decisions on its basis largely determine the success. Without the use of mathematical methods, today it is difficult to imagine any work with information: its receipt, processing, analysis, and forecasting. Knowing these methods and understanding their essence allows freely navigating in the choice of means for solving both educational tasks and tasks in future professional activities (Anisimova, 2015).

However, how can one motivate a student to study a subject that would seem to be so far from the field of study of a future philologist, journalist, etc.? Certainly, an argument about the need for the comprehensive development of personality or the development of thinking is well-known. In this regard, the authors quote the words of Alexander Ilichevsky, a winner of the Russian Booker Prize, a theoretical physicist by education: "Our world is becoming so busy that technology affects the humanities, and the humanitarian area affects technology and its development. People become much more literate. That was before – physicists, lyric writers. Now, this is completely pointless. It is a

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

bad physicist who knows nothing about the lyrics, and vice versa".

The issues of motivating students of one of the humanitarian areas – a legal one – to study mathematics were considered in (Ilyin *et al*., 2015), which emphasizes the importance of mathematics as the leading discipline in the logical argumentation of visible phenomena of legal practice.

The authors' experience in teaching mathematics at humanities faculties shows that one of the strongest incentives that "drives" a young person, encourages him/her to study the subject, is the desire to understand the essence of, for example, mathematical and, in particular, geometric metaphors in literature. The poetry of the Nobel laureate Joseph Brodsky is indicative of this conversation, all the more so because studies of the poet's works, of which there are a huge number, are mainly carried out (with rare exceptions (Kolker, 2008; Kostin *et al*., 2016) by people who are also very far from mathematics (for example, (Belyi, 2007; Gasparov, 1995; Glazunova, 2008; Gordin, 2003; Polukhina, 1989; Bethea, 1994; Bethea, 1993)).

This article illustrates specific examples of Joseph Brodsky's amazing knowledge of the exact sciences and the depth of understanding of the essence of mathematical and physical laws. The poetry of the author shows the way a mathematical language becomes a poetic language, mathematical images turn into a poetic metaphor.

A special place in the work is given to the study of the poet's interest in the greatest geometers Euclid and Lobachevsky, traced over a long period of his poetic activity.

In Joseph Brodsky's poem "Lullaby of Cape Cod" (hereinafter all citations are from the publication (Brodsky, 1994)) there are the following lines:

"…The change of empire is connected with a buzz of words,

with salivation as a result of speech,

with Lobachevsky's sum of other angles,

with a gradual increase in chances of meeting

parallel lines (the ordinary one at

the pole) …"

The facts of the history of mathematics are additional touches in the composition of this work. However, as practice shows, humanities students usually do not understand completely the essence of the problems hiding behind the above quote. Moreover, it is obvious that the author of these lines did not fully understand the background of the mathematical problems associated with the voiced quotes. On the one hand, the initial message "with Lobachevsky's sum of other angles" is understandable (and true) – a direct reference to the everyday understanding of the "angle" seme as a place of residence and a mathematically meaningful poetic metaphor are surprisingly intertwined in this phrase: in Lobachevskian geometry, the sum of the angles of a triangle and a convex polygon is less than in "ordinary" – Euclidean geometry. However, the following thought "with a gradual increase in chances of meeting parallel lines, the ordinary one at the pole ...", although intuitively understood, raises some questions from the point of view of mathematics, namely, it is not entirely

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

correct. In particular, the quote probably refers to the pole as a point on the sphere (north or south), and parallel lines most likely appear to the author as meridians on the sphere. Certainly, the line on Lobachevsky's plane plays the same role as the meridian on the sphere. However, from a mathematical point of view, even parallel lines in Lobachevskian geometry do not have common points (or have them at absolute, i.e. at infinity), although they are asymptotically converging towards parallelism. The point that is unattainable for the "inhabitants of Lobachevsky's plane" in which the parallel lines "meet" is the pole of the common perpendicular of these parallel lines lying in the so-called ideal region of Lobachevsky's plane, all points of which are unattainable from "one's own region" of Lobachevsky's plane. However, these are already very specific facts of non-Euclidean geometry, which the author could hardly have known, and if he had known them, he would not have overloaded the poetic text with such material.

It is known that a person's education at almost any stage is inconceivable without resorting to mathematics, to its history. Mathematical knowledge has become an integral part of the general human culture. Currently, the subject "mathematics" is taught at almost all faculties, including faculties of humanities. A lot of research, both Russian and foreign, has been devoted to the problems of teaching mathematics to humanities students (Baubonienė et al., 2018; Girdzijauskaite et al., 2019; Alajmi, 2019).

In particular, the article "Humanitarian Mathematics" notes that an intellectual living in the modern world cannot but master elementary, general cultural mathematical facts, know what probability is, understand the word "bifurcation" or know about the existence of non-Euclidean geometry. At the same time, attention is drawn to the fact that the methodology for presenting the material should be fundamentally changed, taking into account the fact that mathematics is an integral part of civilization, an essential element of the general culture, the language of the scientific world view (Rozov, 2003).

In the book Mathematics Helps Linguistics, the authors present the possibilities of applying mathematical methods in the humanitarian field of linguistics, talk about the application of mathematical methods in language learning, namely, the use of mathematics in language studies or linguistics, the exact methods for solving problems arising in linguistics (Kleidlin and Shmelev, 1994).

The issues of using the symbolic language of mathematical logic were discussed on the pages of the journal Mathematics in School (Gladkiy, 1991). For more effective mastery of the material by some students, some authors propose preparing tasks for seminars and practical classes, the contents of which demonstrate the practical focus of mathematics (Gavrilycheva, 2016). Further analysis of literature on the theory and methodology of teaching mathematics to humanities students allows identifying several approaches to solving the problem of filling the discipline with new content (Korableva et al., 2019).

First, one of the approaches to the formation of a mathematics training program is to develop completely new content in the form of a general overview course (Shikin, 2000).

Second, some researchers propose to adapt the mathematics course to the level of students' training, without making any special changes to the content (Gavaza, 2003; Dergunova, 2007; Solovyova, 2006), etc.

Third, it is proposed to widely use information technologies, e-learning in teaching humanities students (Medintseva, 2004; Medintseva, 2005; Golubev and Testov, 2011).

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

Fourth, taking into account the brief time frame of humanities training courses, an intensification of teaching mathematics is proposed, which consists in solving two interrelated tasks: improving the quality of training and simultaneously reducing time expenditures (Dmitrieva, 2011).

In addition to the considered works, certain issues of teaching mathematics to humanities students are described in the works of Bogatov (Bogatov, 2000), as well as in PhD theses by Bordachenko (Bordachenko, 2003), Ivanova (Ivanova, 2005), Nabatnikova (Nabatnikova, 2001), Pomortseva (Pomortseva, 2000) and others. Many researchers have repeatedly presented to the public their vision of the problem in speeches at scientific-methodological conferences and in journal articles (Uspensky, 2007; Uspensky, 2014), embodied it in books and textbooks (Shikin and Shikina, 1999). A group of authors (Dvoryatkina *et al*., 2017) discusses an urgent issue – the synergy of humanitarian and mathematical knowledge in the context of solving the most important interdisciplinary issues. The theoretical substantiation of the integration of mathematical, humanitarian and informational knowledge is given; an integrative course "Mathematical Methods in Linguistics" is presented. The same authors point to the need to use a set of mathematical methods for the statistical accuracy of determining the author's style and developing an integrative mathematical model based on modern computer technologies (Dvoryatkina and Dyakina, 2015; Hrivnák et al., 2019).

The contribution of foreign researchers to the popularization of mathematical education for humanities should be noted. In particular, in the article "About the Relevance and Methodology aspects of Teaching the Mathematical Modeling to Pedagogical Students", the author substantiates the need to study mathematical modeling by students of pedagogical universities, which is caused by the total penetration of mathematics in various sciences, including the humanities (Minkin *et al*., 2017). The need to establish interdisciplinary links between mathematics and the humanities is discussed in "Mathematics and Interdisciplinarity: A Study about Teaching Materials" (Dijalmary, 2016), as well as in (Shatunova *et al.*, 2019; Franco and Bedin, 2019). A teacher of mathematics and methodology courses for teachers at the University of Texas notes the importance of ideas in teaching mathematics (Stephen, 2001). The difficulties of teaching mathematical modeling to humanities students are discussed in the article "Some reflections on the teaching of mathematical modeling" (Warwick, 2007).

Despite the importance of the above works to study the problems of teaching mathematics to humanities students, they lack clear recommendations on how to change the content of mathematics training programs.

II. MATERIALS AND METHODS

During experimental work, empirical research methods were used: observation, testing, questioning, methods of statistical processing of research results. It is known that the effectiveness of mastering a discipline or module, including mathematics, largely depends on students' motivation. No one will dispute the influence of mathematics on philosophy, painting, sculpture, and architecture. Mathematics plays the role of an extra in each of these areas, and its content becomes an object of art. Let us touch upon some mathematical facts in Brodsky's works, without seriously affecting the depth of the philosophy of space and time of his poetic World.

In the poem "The End of a Beautiful Era", it is written:

"And it's not that Lobachevsky is strictly observed here,

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

but the apart world must narrow down somewhere, and here –

here the end of the perspective...”

Ideally, the reader should understand this as the connection between Lobachevskian geometry and projective geometry, or rather, it would be nice to know that Lobachevskian geometry is interpreted on the projective plane, where the concepts of “pole” and “perspective” are considered, knowing that each of the conditionally mathematical concepts in Brodsky’s works always has a different meaning.

The following rhyme chain “chronos-cone” is associated with Minkowski geometry. The mention of Euclidean, Lobachevskian, and Minkowski geometries appears in the poet’s work in the order in which they arose historically, and the change of the “Euclidean Empire” to “Lobachevskian Empire” is simultaneously a metaphor for the reflection of historical and mathematical facts.

The problem of the fifth postulate explicitly appears repeatedly in the poet’s works and serves as a multi-valued poetic metaphor:

“...Euclid himself,

with the sum of two angles and darkness

around, promises another one;

and this is like a form of marriage...”

This is from the second part of “Singing without Music”, which is replete with geometric images as metaphors. To verify the accuracy of the author’s thought, the authors of the article give the wording of Euclid’s fifth postulate: “and if a straight line crossing two straight lines makes the interior angles on the same side less than two right angles, the two straight lines, if extended indefinitely, meet on that side on which are the angles less than the two right angles”. For humanities students, it should be clarified that the word “straight” describes the lines and the word “right” defines a measure of the angle.

They tried to dispel the darkness around the fifth postulate problem for two millennia. Modern schoolchildren in the seventh grade know the statement equivalent to the fifth postulate, the wording of which was proposed by the Scottish mathematician and geographer John Playfair in the eighteenth century: “Through a given point not on a given line on the plane, you can draw no more than one line that does not intersect this line”. The independence of the fifth postulate from the remaining axioms was proved by replacing this statement with its negation and constructing a new geometric system. Knowing the dramatic history of recognition of Lobachevsky’s discoveries is one of the factors that arouse students’ interest in the subject. Here Lobachevsky’s ethical dominants when promoting the ideas and their rejection by the largest Russian mathematicians turn out to be significant. The reaction of Academician Ostrogradsky, who gave not just negative, but derogatory feedback on Lobachevsky’s submitted work, is perceived by the audience as expected and natural, although after this a libel on Lobachevsky appeared in “Son of the Fatherland” (1834). Ignoring Lobachevsky’s discovery by Academician Bunyakovsky in his article of 1872 (Bunyakovskii, 1872), which gave another “proof” of the fifth postulate after recognizing Lobachevskian geometry in Europe, after constructing its first interpretations, causes sincere surprise among students (fortunately, all of these publications are currently publicly available).

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

The last line in Brodsky's quatrain above is also filled with a deep, including mathematical, meaning. "Form of Marriage" is an analogue of a contract and, therefore, the adoption of the appropriate axiomatics, which is determined by Euclid's fifth postulate or his denial according to Lobachevsky. This Brodsky's ability to feel and convey the mathematical essence of the phenomenon, not being a mathematician, is admirable.

Let us get back to the second part of "Singing without Music" by Brodsky. One may notice that this part is constructed as a solution to the geometric proof problem with bringing the structural components of the problem: "This is what is GIVEN to you and me", although this is a poem about love.

Euclid's name, his geometry is associated in Brodsky's works with the theme of the Motherland:

"...comfort you now

in the language of native aspens; and yes,

let their shadows in the snow

crowd like Euclid's triumph".

Brodsky also created mathematical metaphors based on a purely external resemblance:

"A hawk over your head, like a square root

from the bottomless sky, as before prayer".

("Roman Elegies"),

and in the form of laconic definitions: "loneliness is a man squared" ("Towards Urania"), and the standard formulations of school tasks serve the goals of art, mathematical characteristics act as poetic epithets.

Modern educational standards contain a requirement for the programs of all disciplines and modules for the formation of bachelor and master competencies necessary in students' further professional activities. Therefore, the discipline "Mathematics" should contribute to the training of future professionals in their field of study. To evaluate this contribution, a study was conducted in a group of 30 first-year students of the Faculty of History and Philology in two stages: before studying a mathematics course (with elements of the history of mathematics) and the basics of mathematical information processing and after.

At each stage, students were offered different sets of citations of poems, based on mathematical and historical-mathematical facts to a greater or lesser extent, the meaning of which was required to be clarified. Certainly, the interpretation of each metaphor or multifaceted image is subjective. Nevertheless, according to students' descriptions, it can be concluded that they adequately perceive the mathematical component of the images in the proposed fragments of the works. Interpretations, which, in the authors' opinion, adequately reflect the mathematical content of metaphors, were conditionally called correct.

Besides, having set a goal to develop a mathematics program for humanities students, with motivational content for its study, the authors conducted a survey among students on the importance

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

of the role of mathematics in their future professional activities.

At the first math lesson, students were offered a set of tasks of practical oriented content, designed to reveal their degree of readiness to use mathematical methods to solve applied problems that reflect their future pedagogical activity, as well as correctly interpret the results.

In addition, they were asked to answer the following questions:

1. Do you think that any person needs mathematical knowledge?

2. Do you, a future teacher, need mathematical knowledge?

3. Do you know exactly where mathematical knowledge will be applied in future professional activities?

4. Do you know the statistical methods of information processing?

5. In your opinion, does the level of development of mathematical abilities affect the levels of development of other subject abilities?

Students were also asked similar questions after mastering the discipline “Mathematics and the Basics of Mathematical Information Processing”. Fig. 1 shows the results of the questionnaire survey of students, upon which it can be concluded that the number of answers “yes” to all the questions posed is increased. The largest increase is seen in points 1, 2 and 3, i.e. students became convinced that they would need mathematics while working at school as a teacher, and they know where and how to apply it.

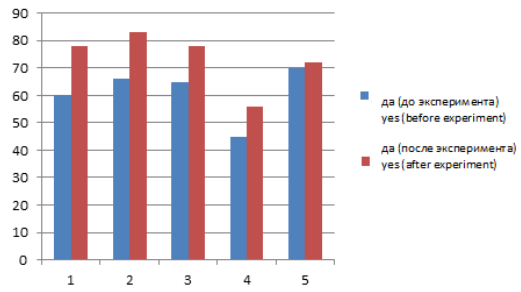

Figure 1. Results of the questionnaire survey of students

The next stage of the study was a survey of students on understanding the quotes from Students were asked, in particular, to answer the questions: 1) Who is the author of the quotes below:

a) “...Euclid himself,

with the sum of two angles and darkness

around, promises another one;

and this is like a form of marriage...”;

b) “...Euclid himself,

with the sum of two angles and darkness

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

around, promises another one;

and this is like a form of marriage...";

c) etc.

2) How do you understand the meaning of these poetic fragments?

The results of the first stage are presented in Fig. 2.

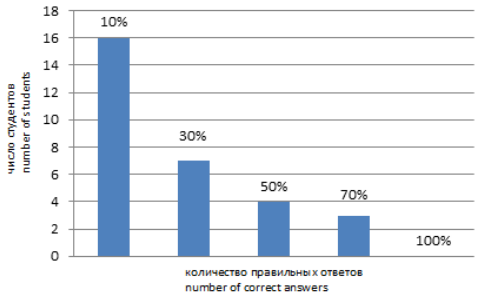

Figure 2. Results of the initial survey

The second stage of testing had the following results (Fig. 3):

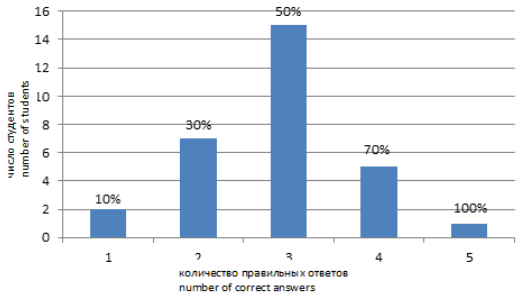

Figure 3. Results of the second survey

III. ResultS AND DISCUSSION

The graphs show that, as a result of studying the course, the distribution of the correct answers has changed fundamentally for the better, which confirms the productivity of math lessons to increase the competence of philologists even in their specialized field.

Here it should be emphasized that the processing of questionnaires revealed that humanities students could not even explain how "academic performance" differs from the "quality of knowledge" before studying mathematics, and did not know the combinatorial methods of processing information.

Therefore, after the analysis, it was decided to introduce the discipline "Mathematics and the Basics of Mathematical Information Processing" in the curriculum instead of the discipline "Mathematics", after mastering which the following educational results should have been obtained:

- the ability to comprehend literary metaphors based on facts from the history of natural and exact sciences;

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

- the ability to solve practical problems that arise in the process of the teacher's work, using the mathematical tools;

- the ability to monitor and evaluate educational achievements, current and final results of the mastering of the principal educational program by students, mathematical processing of the results of the pedagogical activity.

After having mastered the discipline program, similar studies were conducted; they showed that the declared educational results have been achieved.

IV. CONCLUSIONS

The focus of humanities students on mathematical images in the poetry of Joseph Brodsky encourages them to clarify the motives that prompted the author to include mathematical concepts in his works. In the authors' opinion, such an active appeal of the poet to the language of mathematics can be explained by several reasons: deep respect for mathematics, an underlying feeling of the existence of a criterion of truth in it. Accordingly, thoughts expressed in the language of mathematics may have seemed to him more reasoned, more accurate, weighty in the structure of specific poetic works. Besides, the poet's passion for knowledge, for mathematics, and, perhaps, his regret that he had to learn the exact sciences so little are obvious. However, taking into account his education (he did not complete the eighth grade), his knowledge in the exact sciences and a depth of understanding of the essence of mathematical and physical laws are surprising. This is one of the most significant arguments for philologists to study the basics of mathematical knowledge.

The materials presented can be used in teaching mathematics in any humanitarian field of study and educational level. Note that the appeal to Brodsky's poetry is due to the fact that Brodsky is, if not the most read, one of the most discussed Russian-language poets of modern times. Obviously, acquaintance with Brodsky's poetry is also useful for future math teachers (Kostin et al., 2016).

REFERENCES

[1] Anisimova T.I. (2015). Forming bachelors' labor actions in teacher training when studying disciplines of mathematical and natural science cycle. *International Electronic Journal of Mathematics Education*. Vol.10, Issue 3, Pp.157-165. DOI: 10.12973/mathedu.2015.111a

[2] Alajmi, M. M. (2019). The impact of E-portfolio use on the development of professional standards and life skills of students: A case study. *Entrepreneurship and Sustainability Issues*, 6(4), 1714-1735. doi:10.9770/jesi.2019.6.4(12)

[3] Belyi A. (2007). "Bad Physics" by I. Brodsky. *Neva*. No. 5 URL: http://magazines.russ.ru/neva/2007/5/be14.html (reference date 14.01.2018).

[4] Bethea D. (1994). Joseph Brodsky and the Creation of Exile. Princeton: Princeton University Press.

[5] Bethea D. (1993). Joseph Brodsky as a Russian Metaphysical: A Reading of 'B Bol'shaia elegiia Dzhonu Donnu'. *Canadian-American Slavic Studies*. Vol. 27. № 1-4. Pp. 69-89.

[6] Bogatov, D.F. (2000). Fundamentals of Informatics and Mathematics for Lawyers: Textbook. Vol. I, II. Moscow: "PRIOR Publishing House".

[7] Bordachenko S.I. (2003). Professional training of students of a liberal arts university in the field of mathematics. *Dis. Cand. Ped. Sciences*. *Skhodnya*. URL: http://www.dissercat.com/content/professionalnaya-podgotovka-studentov-gumanitarnogo-vuza-v-oblasti-matematiki (reference date: 04/04/2018).

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

[8] Baubonienė, Ž., Hahn, K. H., Puksas, A., & Malinauskienė, E. (2018). Factors influencing student entrepreneurship intentions: The case of lithuanian and south korean universities. Entrepreneurship and Sustainability Issues, 6(2), 854-871. doi:10.9770/jesi.2018.6.2(26)

[9] Brodsky I.A. (1994) Selected poems. Moscow. "Panorama".

[10] Bunyakovskii V.Ya. (1872) A note on the question of parallel1 lines. *Mat. Collection*. 6: 1, Pp. 77-82.

[11] Dergunova H.A. (2007) Differential training in probability theory and mathematical statistics of students-sociologists in higher education: *Dis. Cand. Ped. Sciences. Astrakhan*. URL: http://www.dissercat.com/content/differentsirovannoe-obuchenie-matematike-na-osnove-ucheta-poznavatelnykh-stilei-obuchayushch (reference date 21.12.2018).

[12] Dijalmary Matos Prates Chas (Colégio Estadual Polivalente de Curitiba). Mathematics and inter disciplinarity: a study about teaching materials Estação Científica. (2016). 6(3): Pp. 97-109 DOI 10.18468/estcien.2016v6n3.p97-109

[13] Dmitrieva M.N. (2011). Methods of teaching mathematics to students of humanitarian specialties of higher educational institutions in the context of training intensification: *Dis. Cand. Ped. Sciences. Tula.* URL: http://www.dissercat.com/content/metodika-obucheniya-matematike-studentov-gumanitarnykh-spetsialnostei-vuzov-v-kontekste-inte (reference date: 8.04.2018).

[14] Dvoryatkina S.N., Dyakina A.A. and Rozanova S.A. (2017). *Synergy of humanitarian and mathematical knowledge as a pedagogical condition for solving interdisciplinary problems. Integration of education.* Vol. 21, No. 1. Pp. 8-18. DOI: 10.15507 / 1991-9468.086.021.201701.008-018

[15] Dvoryatkina S.N. and Dyakina A.A. (2015). On variability of authors' style under the influence of the socio-cultural environment in the context of dialogue of natural scientific and humanitarian cultures. *Mediterranean journal of social sciences.* MCSER Publishing, Rome-Italy. Vol. 6, №. 5 S4. Pp. 167–171. URL: http://elibrary.ru/item.asp?id=24553891 (reference date: 25.12.2017).

[16] Franco, V. D. A., & Bedin, E. (2019). The chemistry teaching and the high school student: A case study in the state basic education of esteio city, brazil. [O ensino de química e o aluno do ensino médio: Um estudo de caso na educação básica estadual do Município de Esteio, Brasil] Periodico Tche Quimica, 16(33), 118-129.

[17] Gasparov M.L. (1995). Brodsky's rhyme Selected articles. Moscow. Pp.83-92.

[18] Gavaza T.A. (2003). Professional-pedagogical orientation of the course of mathematics for the humanities faculties of the pedagogical higher school: *Dis. Cand. Ped. Sciences*. Orel. URL: http://www.dissercat.com/content/professionalno-pedagogicheskaya-napravlennost-spetsialnoi-podgotovki-uchitelya-matematiki-v- (reference date: 8.04.2018).

[19] Gavrilycheva M.G. (2016). Problems of teaching mathematics to students of humanitarian directions. *Bulletin of the Moscow International Academy*. No 1. Pp. 174-177.

[20] Girdzijauskaite, E.; Radzeviciene, A.; Jakubavicius, A. (2019). Impact of international branch campus KPIs on the university competitiveness: FARE method, Insights into Regional Development 1(2): 171-180. https://doi.org/10.9770/ird.2019.1.2(7)

[21] Gladkiy A.V. (1991). Mathematics in the Humanities School. *Mathematics at School*. No. 6. Pp. 6-9.

[22] Glazunova O.I. (2008). Joseph Brodsky: metaphysics and reality. St. Petersburg: St. Petersburg State University, *Nestor - History of the Russian Academy of Sciences*. 312 p.

[23] Golubev O.B. and Testov V.A. (2011). Educational network projects in teaching mathematics. *The role of innovative universities in the implementation of the National Education Initiative "Our New School": Conference Abstracts March* 15-16. Nizhny Novgorod, 2011. Pp. 114-115.

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

[24] Gordin J. (2003). Wanderer. Poetic symbolism of Joseph Brodsky. The World of Joseph Brodsky. Guide. Collection of articles. St. Petersburg: Publishing House of the "Zvezda". Pp. 233-246.

[25] Hrivnák, M., Melichová, K., Fáziková, M., & Roháčiková, O. (2019). University graduates, knowledge spill-overs and localization of knowledge intensive ventures-case of post-socialistic country. Entrepreneurship and Sustainability Issues, 7(1), 146-165. doi:10.9770/jesi.2019.7.1(12)

[26] Ilyin A.G., Kuzmenko V.I. and Kostina N.N. (2015). Teaching mathematics to students - bachelors of law faculties. *Internet journal "NAUKOVODENIE*". Vol. 7. №5. URL: http://naukovedenie.ru/PDF/153PVN515.pdf (reference date: 04.20.2018). DOI: 10.15862 / 153PVN515

[27] Ivanova A.D. (2005). Technological approach to the design of the methodological system of teaching mathematics for the humanities. *Dis. Cand. Ped. Sciences. Moscow.* 147 p. URL: http://www.dissercat.com/content/tekhnologicheskii-podkhod-k-proektirovaniyu-metodicheskoi-sistemy-prepodavaniya-matematiki-d (reference date: 04.18.2018).

[28] Jon Warwick (2007). Some reflections on the teaching of mathematical modeling. *The Mathematics Educator*. Vol. 17. No. 1, Pp. 32–41.

[29] Kleidlin G.E. and Shmelev A.D. (1994). Mathematics helps linguistics: book for students. Moscow: Education. 176 p.: illustrated. – (World of knowledge).

[30] Kolker Yu. (2008). A few observations on the poetry of Joseph Brodsky. Kolker Yu. *The Ides cool [Literary articles and essays]*. Helikon-Plus, St. Petersburg. URL: http://yuri-kolker.com/articles/Brodsky.htm (reference date: 15.04.2018).

[31] Korableva, O., Durand, T., Kalimullina, O., & Stepanova, I. (2019). Usability testing of MOOC: Identifying user interface problems. Paper presented at the ICEIS 2019 - Proceedings of the 21st International Conference on Enterprise Information Systems, 2 468-475.

[32] Kostin A.V., Kostina N.N. and Minnegulova E.O. (2016). The use of imitation technologies in the preparation of future teachers. *Internet-journal "The World of Science"*. Vol. 4, No. 1 URL: http://mir-nauki.com/PDF/19PDMN116.pdf (reference date: 10.03.18).

[33] Medintseva I.P. (2004). A model of the methodical system of teaching mathematics using information technologies in a liberal arts college. *Scientific Bulletin VAGS: Collection of Sci. Art*. – Issue 4. Mathematical modeling, information systems and nonlinear dynamics. – Volgograd: Publishing house of VAGS.

[34] Medintseva I.P. (2005). Methods of teaching mathematics using an electronic textbook in a liberal arts university (on the example of the section "Mathematical Statistics"): *Dis. Cand. Ped. Sciences. Moscow.*

[35] Minkin A.V, Kostin A.V. and Kostina N.N. (2017). Mobile devices and software applicable in Russian physical culture and sports GTO complex tests. *Teoriya i Praktika Fizicheskoy Kultury*. Vol.8. Issue. - Pp.34-36.

[36] Nabatnikova N.V. (2001). Didactic conditions for the development of the interest of students of humanitarian faculties in the study of mathematics. *Dis. Cand. Ped. Sciences*. Lipetsk. 172 p. URL: http://www.dissercat.com/content/didakticheskie-usloviya-razvitiya-interesa-studentov-gumanitarnykh-fakultetov-k-izucheniyu-m (reference date: 12.02.2018).

[37] Polukhina V. (1989). Joseph Brodsky: A Poet for Our Time. Cambridge: *Cambridge University Press*.

[38] Pomortseva S.V. (2000). Realization of intersubject ties of computer science with mathematics in teaching computer science to students of the faculty of primary school of a teacher training University: Dis. Cand. Ped. Sciences: Omsk. 155 p. URL: http://www.dissercat.com/content/osushchestvlenie-mezhpredmetnykh-svyazei-informatiki-s-matematikoi-v-obuchenii-informatike-s (reference date: 2.03.2018).

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)

[39] Rozov N.Kh. (2003). Humanitarian Mathematics // Mathematics in Higher Education. No. 1. P. 55.

[40] Shatunova O, Anisimova T, Sabirova F and Kalimullina O. (2019). Steam as an innovative educational technology. *Journal of Social Studies Education Research*. Vol.10, Issue 2. Pp.131-144.

[41] Shikin E.V. (2000). On Mathematical Courses for Specific Humanities. *All Russia Conference "Mathematics and Society, Mathematical Education at the turn of the century*". Moscow. MCNME. 16 p.

[42] Shikin E.V. and Shikina G.Ye. (1999). To Humanitarians about mathematics. Moscow: AGAR. 333 p.

[43] Solovyova A.A. (2006). Professional orientation of teaching mathematics to students of humanitarian specialties. Text: the author's abstract. *Dis. Cand. Ped. Sciences*. 23 p.

[44] Stephen J. (2001). Pape and Mourat A. Tchoshanov. The Role of Representation(s) in Developing Mathematical Understanding. Source: Theory into Practice, Vol. 40. No. 2. *Realizing Reform in School Mathematics* Pp. 118-127.

[45] Uspensky V.A. (2007). Mathematical and humanitarian: overcoming the barrier // Znamya. No. 12. Pp. 185-173.

[46] Uspensky V.A. (2014) Mathematics is a humanitarian science. *Troitsky variant*. January 28 (No. 146). URL: www.trv-science.ru/2014/ 01/28

ISSN 1869-0459 (print)/ ISSN 1869-2885 (online)