

NORMATIVE APPROACH TO ETHNOMATHEMATICS: LINGUISTIC AND PHILOSOPHICAL GROUNDS

The article presents the results of a theoretical analysis of linguistic and philosophical grounds of ethnomathematics. The authors focus their attention on the basic mechanisms involved in the process of acquisition of scientific concepts – their perception and putting them into practice. The specific features of perception of scientific terms are treated according to Luria's theory, and the practical aspect is analysed in connection with Wittgenstein's theory of language games that describe the normative potential of language.

Keywords: ethnomathematics; normative approach; concepts; perception; language; practice.

The 21st century seems to have put an end to the tendency of opposing different subjects and spheres. Globalization of the majority of world processes leads to global integration of knowledge. This assumption forms the basis of the present research that is aimed to treat the rapidly developing sphere of ethnomathematics from the point of view of some basic psycholinguistic and philosophical ideas by L. Wittgenstein, A. Luria and other researchers.

The term “ethnomathematics” was introduced to the American Association for the Advancement of Science by the Brazilian scientist U. D'Ambrosio, since then it has evolved into a sphere that covers a wide range of ideas and research results on the interrelation of mathematical concepts with cultural phenomena. Naturally, such an understanding of mathematics opens new perspectives for mathematical research and teaching of mathematics [1. P. 44].

It should be underlined that ethnomathematics became widely known due to its positive contributions to the spheres of philosophy, history and pedagogy of mathematics. According to A. Pais the prefix “ethno” has modified the value of mathematics for social sciences by putting it in the world of people, practices and languages and established an unprecedented social, historical, economic and political criticism aimed at today's hegemony of mathematical knowledge that has served as a resource for various practices of domination [2. P. 33].

In fact, it is convenient to remember that ethnomathematics program of D'Ambrosio emerges not only from the general discussion on ethnosciences, but also from the conception that appeared in the United States in the form of the so-called multiculturalism. According to Stathopoulou, ethnomathematics embraces along with the strengths and weaknesses of the variety of ethnosciences the practices that arise from an appreciation of the cultural contexts of human experience [3. P. 27].

In fact, whatever the sense granted to the “ethno” prefix, it refers to the human being as a planetary identity characterised by a unity of its cognitive and biological process. The anthropological structuralism of Levi Strauss with his thesis of permanence of symbolic functions, combined with the linguistic structuralism of Saussure in relation to the meaning of words, were both used by Jean Piaget in the organization of his thesis of cognitive structuralism of the human species. On the other hand, by following in a certain way social structuralism in a Marxist perspective, Vygotsky looks for the social and cultural origin of basic cognitive processes in the so-called historical-cultural approach. In his conception the structure of thinking depends on the structure of activities that are

typical for different cultures. Furthermore, language has a very important cognitive and communicative function; that is why language performs a mediator role in the act of knowing. Thus, the meaning of the words is actually a generalization, a concept, a referent that allows us to get to know objects and phenomena by means of their correlation with our experience.

At this point we turn to the conception of the socio-cognitive structuralism with a focus on individual and collective processes. For both, albeit the existing diversity, there is a consideration of human beings as possessing something in common, some universal features. Therefore, if the human being is unique and universal in his mental process, but extremely diverse in what he produces, we should get closer to the social and cultural reality of the other person to interpret his / her cultural production different from ours though subject to the universal mental processes common for any human being [4. P. 48].

This “rapprochement” with socio-cultural reality is in the spirit of contemporary multiculturalism: different cultures would be the result of different ways in which several human groups submitted to different environmental and historical conditions develop their creativity, which is a common characteristic of the whole humanity [5. P. 57]. In this way we see that “culture” as a concept becomes a tool, a resource used to think of mathematical ideas and the process of their learning and teaching. Terms and notions such as mathematical acculturation, mathematical enculturation (Bishop, 1988), family background, and socio-cultural reality gain space in discussions about pedagogical situations. According to Stathopoulou, culture provides a lens for understanding concepts with their variations [3. P. 31].

Therefore, D'Ambrosio believes culture to be a condition of ethnomathematics: “the mathematics which is practiced among identifiable cultural groups such as national tribe societies, labor groups, children of certain age brackets and professional classes” [1. P. 45]. A number of ethnomathematical studies focus on the study of relationships between mathematics in and out of schools, by looking for methodological and didactic possibilities through a critical position about school curriculum and teacher training programs [6–9]. Likewise, their conclusions suggest that teachers should develop their classroom practices by recognizing knowledge and strategies from cultural environment in relation to institutionalised mathematical knowledge. In addition to this, discussions about social practice, identity, diversity and difference have also been prominent.

For years now, several criticisms have been built on ethnomathematics [2, 10–14] mainly those that address the issues of contextualised teaching; use and application of mathematics via modeling process, search of sense and meanings for mathematical concepts in the experience of students, etc. Most of these studies are focused on the relationship between mathematics and culture. We agree with Stathoupoulou that culture in anthropological and sociological sense has carried along with it very important political implications. However, under this understanding, ethnomathematics has not sufficiently helped students learn mathematics. According to Stathoupoulou “It might be more accurate to say that the concept of culture has functioned more as an obstacle to learning” [3. P. 34].

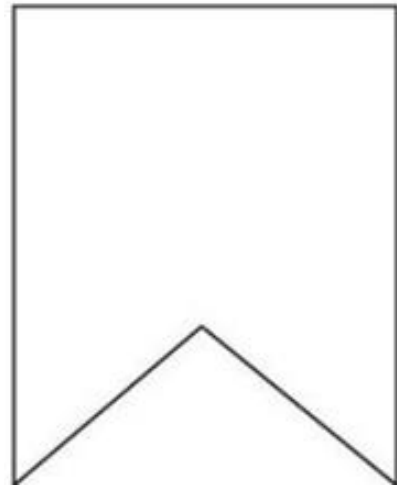
At the moment we think of reconsidering what has been said by cognitive sciences mainly with respect to the structure of thought and its relation with culture as well as the premises of multiculturalism about diversity and identity. In a global world that operates multiple intra- and intercultural contacts, how can we define borders or cultural categories of identity from which some senses can be given to mathematical concepts? Why should a teacher look for empirical support in cultural environments of meanings of mathematical terms, why not search for those meanings in mathematical science itself? After all, why does the human mind become the source of meaning and action?

Stathoupoulou [Ibid. P. 36] believes that the borders between categories and even identity categories are permeable. For example, a Catholic Latina girl in a North American classroom may or may not have an experience coinciding with what her teacher might expect of a learner of a different origin. Each learner is likely to be determined by a set of cultural contexts that form part of his / her life; at the same time, being individuals, learners have a repertoire of behaviors and ways of making meaning out of experiences that are specific to them. In this respect we should better investigate into the sphere of relation between learner’s cultural and social context, his / her experience and ways of making out meaning.

By taking a multicultural point of view we also notice how the notion of cultural context transforms the concept of culture, making it more general. Some inquiries about the cultural context require us to revisit studies not only about cognition and practice, but also about language. For this purpose, we will be taking into account some ideas developed by Wittgenstein in his “Philosophical investigations” and other authors referring to language and its constitutive characteristic of reality. From our point of view, it is important to assume a normative approach.

Conditioned perception and formation of theoretical knowledge

The close interrelation between linguistic and cultural background of learners and their cognitive abilities may be illustrated by a simple example from teaching practice. In a class of geometry in a graduate course of pedagogy in the Federal University of Rio Grande do Sul (Brazil) a professor showed figure on Picture 1 and asked his students: (1) “What is the name of this figure?”.



Picture 1

Immediately all students answered: “It’s a St. John’s flag” (Picture 2).



Picture 2

Midsummer, also known as **St. John’s Day**, is the period of time in north hemisphere centred upon the summer solstice. Celebrations take place on a day between June 19 and June 25 and the preceding evening. The exact dates vary between different cultures. In Brazil even as a country to the south is not different. The Christian Church designated June 24 as the feast day of the early Christian martyr St. John the Baptist, and the observance of St. John’s Day begins the evening before, known as St. John’s Eve. In Brazilian schools this party is part of the curriculum.

Right after this answer the professor reformulated the question and asked them: (2): If I consider the number of sides, what is the name of this figure?” Among different mathematical terms somebody said: “Pentagon”.

It seems interesting to find out why students were not able to say “Pentagon” in the first place, considering the a context of a mathematics classroom and most of them are planning to teach mathematics in future? What was the change in question 2 that made the expected answer finally arrive? What was provided by the question (2) that the concrete object-oriented perception changed for a geometrical abstract perception? Incidentally, was it more related to the context of language or to that of the kind of activity?

In his research about perception, Luria tells us that the extent to which the perception of subjects who attended school where they mastered abstract geometrical concepts (triangles, squares, circles) differs from that of subjects grown up under the influence of only concrete, object-oriented, practical activities by referring to the names of figures as mountains, doors and coins. Even though he also warns us that it is possible that culturally advanced subjects give concrete object names in isolated instances, the author does not give any explanation whatsoever [15]. Thus, Luria's conclusion did not answer our questions, but it led us to examine his research about deduction and inference on the use of syllogisms. This is because the described situation of naming "a pentagon" seemed to refer much more to how language was involved than to the question of practical activity or attending school.

Syllogisms are sets of individual judgments of varying degrees of generality in certain objectively necessary relationships to one another, e.g.: "Precious metals do not rust, gold is a precious metal; hence, does it rust or not?" [Ibid. P. 104]. According to Luria, a human being whose theoretical thought processes are well developed would perceive the first and second premises as a completed logical relation implying the conclusion, which does not require any personal experience: it happened through a syllogism created objectively by historical experience [Ibid. P. 101]. Most of the subjects investigated by him with little or no school experience seemed not to accept the syllogisms as unified logical systems and very few of them perceived their universal character. They refused to make any inferences about them if they did not correspond to their own experience and cultural context of their lives. On the other hand, subjects with some regular schooling activities or systematic instruction yielded gradually to assume universal judgements with features of abstract verbal and logical deduction. Once more it shows that school activity has its importance in developing the so-called theoretical thought.

But Luria suggests also that this non-acceptance is in relation to "following rules". "For the illiterate subjects, the process of reasoning and deduction associated with immediate practical experience follows well-known rules. These subjects can make excellent judgements about facts of direct concern to them and can draw all the implied conclusions, displaying no deviation from the "rules" and revealing much worldly intelligence" [Ibid. P. 114]. Rules such as: "one could only judge / speak what one has seen"; or "one should not lie" were followed by subject not only to show that the answer to a syllogism should result from their own experience, but also to underline that following these rules has a moral or religious connotation for them. Even though, when those subjects were asked: "What do my words suggest?" they agreed to draw a conclusion answering: from your words it should be that <...> [Ibid. P. 110].

We should point out Luria's perception of practical activity dissociated from school activity, which leads us to opposing of theoretical reasoning to practice-based reasoning. He also attaches the key role to the linguistic aspect, i.e. to the words. Luria's perception in this respect coincides with the conclusion that school activity is perceived as an element outside of cultural life. When the students answered the professor's question about penta-

gon "It's a St. John's flag" they were referring to something from their "practical activity". When the question was reformulated, the professor suggested that they follow a new set of rules to follow.

It should be highlighted that according to Luria, "our intellectual operations involve verbal and logical systems, which comprise the basic network of codes along which the connections in discursive human thought are channelled" [15. P. 101]. If theoretical thought develops, the system of codes will consequently become more and more complex by including not only words (more precisely, meanings, which have a complex conceptual structure) and sentences (whose logical and grammatical structure allows them to function as the basic tools of judgment) but also more complex verbal and logical "devices" that make it possible to perform different operations of thinking without reliance on direct experience.

In other words, theoretical thought would reveal a universal cognitive process that would be discursively focused on certain meanings of words and grammatical structures. Here, the discourse formation process is assuming the role of reflecting our way of thinking, as a mirror that describes it and represents it. In this case, the syllogisms present to Luria, first of all, a way of thinking in which language is exclusively a means of communication. Indeed, syllogisms could be a manner of speaking, a game of words, where structuration follows certain rules and conditions such as accepting the universality of premises, establishing logical hierarchies between them, and not really requiring any empirical correspondence.

Regulation of activity by language rules: Wittgenstein's language games

According to Wittgenstein, speaking a language is a part of an activity, of a way of life. Speaking is an activity regulated by rules connected with extralinguistic factors; following rules is a part of our speech production practices related to their background [16]. Thus, imagining a language is also imagining a way of life. According to Wittgenstein, the way of life embraces all our habits, manners, lifestyles, actions, behaviors, institutions on which our activities are based. And the way of life is closely interrelated with language. Thus, the notion of the way of life – without borders and cultural limitations – is drawn near to the notion of practice in a large sense [17. P. 23].

For this purpose, Wittgenstein coins the term "language games" not only to establish the ruled character of linguistic activities, but also to understand how people interact according to their forms of life and practices that they carry out [18]. Thereby, cooking, farming or business as well as explaining, imagining, describing, questioning, reporting, are all practices, language games and they can take place within and across different domains or subfields. It is also because of this rule-governed character of language games that the meanings of words emerge from uses we make of them in certain situations.

What is the meaning of a word? Wittgenstein would tell us this question is wrong since it suggests just one and definite answer. It depends on which language games are in use and their corresponding set of activities. If we treat the following example: what is the meaning of the word

“two”? “Two” could be a quantity, the second after the first, a pair number, and a prime number. “Two” could mean the second position in a competition or a second choice. “Two” also means a couple, a complement, and an opposition. Indeed, there are many possible interpretations of the word “two”. All these meanings are possible, according to Wittgenstein, we need a language game to choose the right one [17. P. 96].

This pragmatic approach allows us to consider the relation of language to thought not only in performative and communicative functions, but also in a constitutive one regarding everything we know as reality. Thinking is something like speaking to oneself. The way one understands the world is the own-way of being in the world. Language is the own lived and practiced world, simultaneously tool and construction [19. P. 43]. As much as a game, language guides us to understanding of different objects of the world, e.g. what’s the meaning (or reality) of word “two”? In Wittgenstein’s conception, the structure of a language is the structure of reality. Hence, choosing the more adequate meaning is the result of following a rule in relation to a system of references, which works as a horizon of intelligibility.

This point of view also demands for human activities to be considered as complex ruled-governed dynamic and inter-related games, and the culture is not represented as a system of structures but the variable result of interchanges between different activities. Likewise, there is no priority of theory over practice. Neither there is, in the case described by Luria, a priority of school activity over practical experience, as it is impossible to establish any relationship between mathematics learning and of school.

To Wittgenstein, practice is a priority conceived in relation to our actions, forms of life and language accordingly [20. P. 105]. Here, we should highlight the interpretation given by T. Schatzki to Wittgenstein’s words. To him, practices are, first of all, organized nexuses of activity, open-ended sets of doings and sayings organized by understandings, rules, and teleoaffective structures. Teleoaffective structure is a linking of ends, means, and moods appropriate to a particular practice or set of practices and that governs what it makes sense to do beyond what is specified by particular understandings and rules [21. P. 56].

Moreover, the actions that compose a practice are either bodily doings and sayings or actions that these doings and sayings constitute. By ‘bodily doings and sayings’ he means actions that people directly perform bodily and not by way of doing something else. To say that actions are ‘constituted’ by doings and sayings is to say that the performance of doings and sayings equals carrying out the actions [22. P. 53].

People, however, are always carrying out a definite practice. Indeed, actions presuppose practices. We may conclude that both people’s actions and the order of their actions are subject to rules of practice organization. Thus, practices establish social order, first, because they help to mold the practical intelligibility that governs their practitioners’ actions and thereby help to determine the arrangements that people bring about [Ibid. P. 62].

According to A. Miguel, combination of organized activities and bodily doings and sayings, resembles how

Wittgenstein described his “language games” and their rule-following features. We always practice the language with the whole body and not just with culturally ruled vibratory sounds emitted by our vocal cords. In this sense, to perform a practice is the same as to perform a ruled language game; that is, both attempts involve disciplining the body in order to make it follow the rules of that game [23. P. 20].

It is important to remember that the Greek words *praxis* [practice] and *pragma* [action] refer to the same ancient Greek verb *prasso*, which meant: “to perform,” “to carry out”, “to act”, “to stage”, and “to represent”. Thus, language treated as *praxis* suggests that practicing a language game resembles directly performing a stage play; that is, participating directly in a scenic bodily representation. In short, Wittgenstein meant the word “practice” as a direct symbolic-bodily performance of rules that are not open to interpretation because they are based on common ways of doing and saying by human beings [24. P. 621].

We may illustrate this idea by the case of postmen involved in the “world of post” based on the “number” of postal codes. They realize their bodily practices of spatial orientation and localization in a way so that a letter can arrive unequivocally to the addressee. This is because, in the normatively ruled “game” of the Postal Code, the rules governing the meaning that should be given to the “number” that participates in that game are the same rules that should also guide the rule-governed bodily performances of the postman so that a letter can arrive, unambiguously, at the address indicated on the envelope [24. P. 625]. But what if at the end of the process the letter got lost? If that problem occurs, we should investigate the empirical grounds that have nothing to do with the meaning of postal code which has governed the rule-governed game of that practice.

This reflection led us to the idea that the meanings of figures (such as in the case of pentagon), numbers (like the number 2) and actions (such as these of a postman) may be conditioned rather by the performative practices and specific rules than by cultural background or empirical conditions. Obviously, there is a material base in any performed action but it makes sense and produces meanings in relation to a language game.

In that sense, we can also consider mathematics as practices, as language games or at least as a set of rules that govern our ways of doing and saying in composing practices. “Why should I not say that what we call mathematics is a family of activities with a family of purposes?” [18. P. 273]. No more as a static domain of knowledge with fixed meanings, mathematics can also be treated as a domain of propositional and conceptual knowledge. In this context we can say at least that mathematics is a set of rules that govern our ways of doing and saying certain scientific and school practices.

Thereby, Wittgenstein offers us an understanding of mathematics in action. According to him, in one sense, mathematics is a body of knowledge, but still it is also an activity [Ibid. P. 238]. That is, mathematics comprises heterogeneous and dynamic sets of rule-governed symbolic representations.

Many contemporary readings [25–27] of Wittgenstein’s reflections about mathematics have pointed out

that the originality of these reflections has been, primarily, their contribution to the emergence of a normative conception of mathematics that cannot be made compatible with logicist, intuitionistic, formalistic, or conventionalist conceptions, or even with some recent anthropological conceptions like ethnomathematics. In addition, we can see primarily numbers, pentagons, or algorithms as being invariably mathematical objects but they are, first and foremost, signs whose meanings are assigned in relation to performances and actions guided by rules and purposes.

Normative approach to ethnomathematics

As we said previously, normative approach points out a series of developments on issues such as language, practice, culture, mathematics, rules-following and subjects, which modify not only our understanding of ethnomathematics research, but also that of mathematics education as a whole. This is a way of explaining arguments for ethnomathematical research in the future.

First of all, we consider that the concept of culture could yield its place to the Wittgensteinian notion of practice which is related also to the notion of forms of life, breaking down every universal and structural feature of the human being, its social and cultural experience and its thought. This conception of practice does not allow us to accept the notion of cultural context as it is treated by multiculturalism, i.e. as “the place” or environment where the process of meaning happens. Although Wittgenstein admits the interpretation of the cultural context, suggested by the multiculturalism, he uses the notion of “forms of life” to refer to different fields of human activity which are open, socially established and historically situated forms of organization of human interactions.

In the philosophical investigations, Wittgenstein did not speak of language games and forms of life in a unique way. The normative feature of language games guides senses, meanings for all the actions we carry out and different objects we manipulate. According to the activity of rule-following, any existence of essential and universal concepts is impossible to be constructed, discovered or applied. Thus, a question of the type “What is X?” makes no sense. Attribution of meaning as symbolic activity is in accordance with the rules of language games that guide performances and actions. With respect to “mathematical objects”, mathematical signs, or even to the term “mathematics”, there is a need of a practice regulating and guiding their conditions, properties, and understandings. Due to their symbolic nature, mathematical concepts condition

the rules of their interpretation and application, thus, forming “mathematical games” that we believe to be a type of Wittgenstein’s language games.

It is important to point out that in Wittgensteinian understanding of practice the difference between “to know” and “to know how to do” does not exist. This is because there is no distinction between theoretical thought and empirical practice. The normative condition of language imposes a normative condition of knowledge. Hence, practicality and knowledge are both constitutive of the unique process. Such reasoning would also help us to problematize the conception of mathematical knowledge such as “pure” versus “applied” and “theoretical” versus “practical”, as well as the issue of the very conception of learning associated to them. Besides, all these ideas may significantly affect current uses of empirical contexts or cultural environments in teaching mathematics.

Finally, we can say that in the context of ethnomathematics, knowledge will not be seen anymore as mathematical knowledge practiced among identifiable cultural groups but as a group of knowledge that in normative condition constitute actions and models of behavior involving permeable identities. According to Wittgenstein, practices establish social orders, their capacity to create rules mold the intelligibility horizon that governs their practitioners. Thereby, we can differentiate between “practice of subjects” and “subjects of practice”. The difference between these two concepts is fundamental. The first one considers that subjects are the origin of actions whose features are intrinsic. The existence of the “subjects of practice” suggests that the subjects are results of practices, i.e. I am a cooker when cooking; teacher when teaching; learner when learning, etc.

We would like to conclude that all these ideas serve to think and open new paths of research. They are not immediately new solutions for old problems, they merely pretend to contribute to the debate. According to Bloor, it is dangerous to give too quick and easy assent to Wittgensteinian ideas without an adequate appreciation of the underlying arguments [20. P. 112]. The arguments alone mark the difference between depth and superficiality in this area. For example, notice that the conclusion is not that rules are institutions merely in the sense of them being widely accepted. The point is that rules are socially constituted, where the manner of constitution can be identified in terms of self-referential processes. The very ontology of rules is social and grounded in patterns of interaction. The detailed arguments have been worked through in order to make this deeper reading available and to prevent the trivialization of Wittgenstein’s conclusion.

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Keywords: ethnomathematics; normative approach; concepts; perception; language; practice.

НОРМАТИВНЫЙ ПОДХОД К ЭТНОМАТЕМАТИКЕ: ЛИНГВИСТИЧЕСКИЕ И ФИЛОСОФСКИЕ ОСНОВАНИЯ

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Изменения, произошедшие в науке в XXI в., фактически положили конец традиции противопоставлять различные науки и их отрасли. Глобализация основных мировых процессов привела к глобальной интеграции знания. Это предположение лежит в основе данного исследования, направленного на анализ активно развивающейся сферы этноматематики в контексте некоторых основных психолингвистических концепций Л. Витгенштейна, А. Лурии и других ученых. Термин «этноматематика» был впервые введен бразильским ученым Д'Амброзио. Сегодня этноматематика стала широкой сферой исследований о взаимосвязи между математическими понятиями и явлениями культуры. В настоящее время требуется переоценка сложившихся представлений о структуре сознания, взаимосвязанного с культурой, так как в условиях глобализации размываются границы идентичности, которые, по мнению Д'Амброзио и его последователей, определяли особенности усвоения математических понятий. По мнению Статулу, границы идентичности в настоящее время проницаемы, и в образовательном контексте особенности восприятия учащихся определяются целым набором культурных контекстов их жизни и, в то же время, набором моделей поведения и выявления смысла, усвоенным из личного и социального опыта. А. Лурия проводил

экспериментальное исследование особенностей восприятия математических понятий и формирования теоретического знания у респондентов, освоивших основные понятия в школе, и респондентов, не посещавших школу. В результате исследования было выявлено, что школьные занятия способствуют формированию теоретического знания. Однако неверным был бы вывод, что респонденты, не прошедшие школьного обучения, не имеют способностей к теоретическим рассуждениям и обобщениям. По мнению А. Лурия, отличие их результатов обусловлено тем, что они руководствовались другими правилами и моделями речемыслительного поведения и им сложно было мыслить без опоры на практический опыт. Следование правилам лежит в центре концепции языковых игр Л. Витгенштейна. Речь в его концепции воспринимается как деятельность, регулируемая правилами, связанными с экстралингвистическими факторами. Следование правилам, связанным с системой культурных, социальных и личных контекстов, является частью продуцирования речи человеком. Таким образом, значение речевых единиц и, вместе с ними, знаков и понятий возникает из их употребления в конкретных ситуациях. В то же время языковая игра регулирует систему правил для деятельности. Любая деятельность имеет материальную сторону, но значение этой деятельности может быть усвоено только во взаимосвязи с языковой игрой. Опираясь на концепцию Л. Витгенштейна, мы можем заключить, что в контексте этноматематики основные понятия больше не могут рассматриваться как элементы математического знания, соотношенные с определенными культурными группами, но как подчиненная определенным правилам система знаний, которая включает действия и модели поведения, пути речемыслительной и материальной деятельности в условиях пронизываемых идентичностей.

Ключевые слова: этноматематика; нормативный подход; концепты; восприятие; язык; практика.

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