

Ethnomathematics and teacher education: reasoning over the meaning of the students' prerequisite and the teacher's listening

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This paper investigates an approach between ethnomathematics and the mathematics learning processes in the scholarly context – however it does this from an ethnomathematician's perspective, not that of a cognitive psychologist. I have been developing research in the area of teacher education with the objectives of: a) recognizing how much mathematics teachers are aware of the movement/literature on teacher education and, b) searching an understanding how and to what extent they are available/able to appreciate and legitimize the first/previous knowledge of the students. With the help of the results from this research, I have focused on two aspects of mathematics education processes - the notion of the student's prerequisite and the notion of the teacher's "listening" (Freire, 1996) – that play a key role in the mentioned ethnomathematics approach and mathematics learning processes.

KEY WORDS: ethnomathematics, teacher education, prerequisite, first knowledge, cultural diversity.

INTRODUCTION

Ethnomathematics, as a movement in the contemporary world, brings out, according to Vergani, one approach with the most promising currents of critical and transdisciplinary in today's thinking like sociolinguistics, cognitive linguistics, phenomenology, biology of knowledge, semiotics, symbology, holistic paradigm and complexity. (Vergani, 2003, p.127).

Such recognition from an intense researcher who has been for a long time involved in ethnomathematics studies – as a link and holder of current critical-holistic thinking – means a lot to mathematics education both in terms of historic comprehension of knowledge and of political-practical-theoretical tools for other movements on this perspective. Indeed, the importance of ethnomathematics' recognition resides in the fact that, thanks to that approach, today many of us can get space to exercise the struggle against formal disciplines superiority – which, assuming the character of knowledge, exclude the rest – those who do not participate in the formal (academic) sphere.

However, if on the one hand it has been accepted to recognize such potential of Ethnomathematics in the political-philosophical sphere, it has been a consensus, among educators involved in these studies, that to take ethnomathematics as a way/method to school education is a highly complex proposal. In a certain sense, this paper aims to developing the thinking about how this might be achieved through the analysis of teacher educator responses to ethnomathematical problems.

In fact, ethnomathematics has been, on the one hand, very successful in developing itself in education as a way to explicit/legitimate spatial and quantitative relationships implicit on the know-how of one group, revealing – from technique to meaning - the differences, from a social-ethnic group to another, in respect to mathematical relationships. On the other hand, even to D’Ambrósio (1990), the biggest concern in the educational point of view, as well as the essential step to ethnomathematics’ diffusion is to take it to the classroom, it is possible to say that the movement of ethnomathematics as a pedagogical practice is still crawling. Why is it so? What happens in the school operational dynamics that could make ethnomathematics assumptions difficult to be incorporated?

An attempt to answer the question above may be the fact that in the school educational environment, some educators seem to be indifferent to the influence of culture in the understanding of mathematics ideas. Such concern really seems to be a waste of time and effort, important only to anthropologists or, at best, to mathematics education researchers who have not discussed earlier and/or closer on the psychology of mathematics education studies (Meira, 1993). Indeed, from our search for such value among mathematics educators (research results shown ahead), some of them seem indifferent to distinctions of social class and culture, while others seem to wish the elimination of these distinctions. And, naturally, among the latter, there is the questioning if what is worth preserving can be re-built/transmitted by teachings via school.

Although I have chosen this approach to start a discussion about ethnomathematics, I do not intend to leave the subject in this rather negative and explanatory tone. After all, I really believe that the teacher should treat school education via cultural patterns of behavior and knowledge, both because, agreeing with Fasheh, it helps the student to become more attentive, critical, appreciative and more confident to face the mathematical relationships the teacher wants to develop as well as help them to build new perspectives and search new alternatives, “and, we hope to help them to transform some existing structures and relationships”. (Fasheh, 1982, p.8)

ETHNOMATHEMATICS: A POINT OF VIEW

From my point of view, one of ethnomathematics founding basis is the belief that different mathematical relationships or mathematical practices can be generated, organized and transmitted informally, like language, to solve immediate needs. And like an operational means of doing, in the center of the know-do processes of a community, mathematics is part of what we call culture. From this point of view, I not only consider ethnomathematics as the area of study that reflects on the cultural roots of mathematical knowledge, but also as the set of quantitative and spatial relationships, generated in the heart of the cultural community, which compose, frequently, what has been theorized as mathematics.

This ethnomathematical perspective is related to the understanding of the meaning of culture, which has passed by innumerable interpretations over the last century, a plot of signs with which people mean objects, happenings, situations and other people around them – and, each individual possessing the code moves easily in the universe of his/her culture, acts on the certainty of having his/her behavior confirmed by the group (Silva, 1993, p.28). In this sense, the relationships involved/built in both fields – cultural and mathematical are structured, naturally in different levels of epistemological complexity but, certainly, including mathematical objects in the (cultural) plot “of signs with which people mean the objects” (Silva, 1993, p.28).

From what was considered, facing the question “Ethnomathematics, how to interpret it?”, it can be recognized as a line of mathematical education research that investigates the cultural roots of mathematical ideas, indispensable to a better understanding/meaning of one of the education areas – the mathematical education – and the assumptions generating its construction such as, contact with other areas of knowledge, cultural contact, values among others. Ethnomathematical studies, somehow, try to follow the path of anthropology, searching to identify (mathematical) problems from the “other one” knowledge, in the sense of understanding the knowledge of the “other one”. In terms of school, for ethnomathematics the teacher would find meaning in the teaching and learning action if he/she takes as starting point the group’s cultural patterns – not an easy task, because - as mentioned - it is as if he/she were searching to identify and interpret an amount of meaningful (ordained) symbols to “another one” different from him/her.

And, once again, what is this? What different manifestation can we meet in the “other group” that is both essential in terms of cognition and difficult to be incorporated? Based on my experience – with an ethnomathematical view on mathematical education and the teacher’s education context – we frequently meet situations in which different inclinations and different choices manifest – all of them conditioned by cultural values. And, recognize certain aspect of things as a cultural value consists in taking it into account in the decision making, that is, in being inclined to use it as something to take into account upon choice and orientation we give to

problem solutions, to ourselves and to others. The following situation reveals this condition well:

The indigenous teacher Maximino, of Guarani-Kayowa ethnicity, when asked by participants of the Studies Research Group in Ethnomathematics-GEPEM-FEUSP about the nature of arithmetic operations to the Guarani-Kayowa, reveals very well the value put into counting, which by itself is already differentiated from the universal way: Maximino Kayowa explains:

“[...] a family invites another family to have lunch at their home... and when the wife asks the husband “How many people are coming?”, he can answer like this: “they are four and four means the father, the mother, two sons (counting like one) and two daughters (counting like one). “The same sex they are one”. Maximino continues: “maybe the husband answers three, what means the father, the mother and four children, if they are the same blood they are one”. (FEUSP, 11 de abril de 2002)

From the discussion so far, we can recognize that whereas ethnomathematical view searches for detachment necessary not to explain all perceived relations linked to academic/universalized mathematics, maybe we always have to question ourselves - when the discussion context is ethnomathematics - about the existing relation between my knowledge and values and those of the others and about which relations should be established or are established between collective and individual knowledge and values.

This way, facing the question “Ethnomathematics, how to interpret it?”, the answers should have more in view the question “How to interpret the(ethno)mathematics to be worked at school?” - it would be more valuable to mathematical learning that they did not come specially from discussions of mathematics philosophy, but of mathematical education. That is, we do not want to interpret it as a set of disciplines and/or a scientific activity, but as a social-cultural product, opening the way to talk about cultural diversity, difference, interculturality.

FOCUS OF INTEREST: TEACHER EDUCATION

As indicated on the title, one of the focuses of interest in this work is related to teacher education from the ethnomathematics perspective. And from this point of view we have tried to call the attention of educators to the fact that in this immense volume of

investigations about teacher education – most of them already concerned not only with the student’s intellectual needs but also with education’s social functions - “the student has not been out of the teacher education proposals, but he/she has not been in either”. (Domite, 2000, p 44).

In some way, we must encourage the teachers to want to understand more and more, and deeper, the school where they work and the students they receive, that is, generate bigger availability to formulate questions “school, who are you?”, as well as “who are our teachers?” and “who are our students?”. Being able to recognize beforehand who is part of the group, what they know and how they know, can make the teacher notice the potential of taking into account student’s culture in the pedagogical doing process.

From the mentioned perspective - a perspective closer to the wishes of ethnomathematical studies - some initiatives in the teacher education have been precious, specially those ones inspired by Freire’s and Schön’s original ideas.

Freire brings and opens to (school) education the proposal of situating the educational action in the student’s culture. To Freire, the consideration and respect to the student’s “first knowledge” and “the culture that each one brings inside him/herself are the goals of a teacher who sees education under the liberating point of view” (Freire, 1967), that is, recognize it as means to generate a structural change in an oppressive society – although Freire states that (school) education does not reach that objective immediately and, even less, alone.

Schön, in turn, brought to educators the assumption that it is from the teacher’s reflection about his/her own practice that transformations can happen, suggesting to the educator to take the teacher to ways of reflection operation in action and of reflection about action (Schön, 1987). According to the author, it is from reflection about our own practice that transformations can happen.

From what was considered and trying to understand what can be done on the interface of teacher education and ethnomathematics, I came closer and closer to Paulo Freire’s studies, choosing him as basic theorist to answer to my questionings. My highest intent is to propitiate a transformation of the relation we have, as teachers, with ignorance about **who our students are, what they know and how they know about them.**

With these concerns and since one of the basic presuppositions of ethnomathematics is in focusing/identifying/legitimizing the quantitative and spatial relationships based on the knowledge of the "other one", I have been developing research in the scope of teacher education with these objectives: a) recognizing how much teachers are aware of the movement/literature on teacher education in the mathematics educational field; b) searching an understanding of the conceptions of the teachers on education and culture and/or how much they are available/able to appreciate

and legitimize the first/previous knowledge of the students; c) problematizing issues/processes that emerge in the social reality of a classroom, in which the knowledge of the student becomes (by force of circumstances) the axis of the teacher's concern; d) understanding the possible connections between Ethnomathematics and the movement of Teacher Education and, e) to better understand what the ethnomathematics educators would like to see in the movement of teacher education.

This research tried to collect information on the basis of two proposals. The first (Part I) was constituted of interviewing mathematics in-service teachers and postgraduates, supported by questions about teacher education. The second proposal (part II), and here is the main focus of this research, was to request the manifestation of the investigated individuals, based on the confrontation with a situation that is distinct from those of regular standards. It is worth highlighting here that this second part of the research was born from my consideration, beforehand, about the lack of deepness of the answers to be given to the third question of part I - that is, I suspected that the set of ideas that are there had not had an impact on their professional lives' histories. The prepared script is as follows:

Part I - Interview with mathematics in service teachers and postgraduates from these questions:

1. What have you heard about Teacher education?
2. Write/explicit some ideas, challenges or suggestions you have seen or heard related to teacher education.
3. In your opinion, what are the main features we, teachers, have to have/develop when we decide to put in the center of the process of teaching-learning our student's previous feelings, attitudes, opinions, culture and knowledge?

Part II - How would you go forward/continue the lessons like these that were presented to teacher Mário and teacher Janaína (two cases coming out in two different public school classrooms in São Paulo city).

<p>Situation 1 - teacher Mário begins, in one of his 5th grades, a conversation with his students on the calculating division, by asking: Teacher: How do you calculate 125 divided by 8? José (student), who sells bubblegum at the traffic light downtown,</p>	<p>Situation 2 - teacher Janaina begins, in one of her Adult Education Course classrooms, a conversation with the students on the percent calculation: Teacher: What do you know about percentage? How do you do the calculation of a percentage? Luiz: Even today I needed to make</p>
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<p>starts speaking:</p> <p>José: We are more or less 10 "guys", almost all day long, some boys and some girls. Then, we divide like this: more for the girls, who are more responsible than the boys, more for the taller ones than the smaller ones".</p> <p>Teacher: Give us an example, José. For example, how was the division yesterday or the day before?</p> <p>José: Ah! Like this ... there were 4 girls, one of which is small; 6 were tall boys and 2 more or less small. Then we were 12 and the gums were 60. Then, it was given half and half, a little more for the girls. The small girl ended up with 3 and the others with 6 or 7, I do not remember well... The boys...</p> <p>Now you have to put yourself in teacher Mário's position and continue the class...</p>	<p>a calculation... 35% of 195 and I did like this... $19 + 19 + 19$ and then plus 9,5. It's 30 plus 27 ... more or less 10.</p> <p>Teacher: How did you get 19? Tell us a little about your way of calculating.</p> <p>Luiz: Ah! I do not know why I did it like this... every time that percentage appears I divide by ten because somebody taught me this way, and I add the times that it appears... like this... 30% I add three times, 40% I add four times.</p> <p>Teacher: And how did you get 9,5? Tell me the way you thought to do this.</p> <p>Luiz: I know that one has to divide by two when it is 25% or 35% or 45%, but I do not know why I do this</p> <p>Now you have to put yourself in teacher Janaina's position and continue the class...</p>
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So far, questions related to Part II of the research were examined with the analysis of 48 answers, all in-service mathematics teachers. Among these 48 teachers, 28 are public school teachers with more than 10 years of experience, 11 with less than 10 years (3 of them also in private schools) and the last 9 are also postgraduates.

In order to analyze the answers, we took into account two types of constraints:

first, the teacher's perceptions (the one who should continue the "started class") on the situational processes of teacher-students and students-students interactions, and second, how and to what extent the content of such situations have been perceived by the subject teachers and what he/she does in order to take it into account the scholar instructional movement and/or do not distort it. Then, the passages collected under such conditions - grouped and regrouped by similarities of the teachers' attitudes - lead to the configuration of three thematic axis.

The first axis comes from the teacher's desire to transform the real situation into an exercise or mathematical problem - looking towards the teaching of a mathematical content. One of the teachers reacted like this: "Very interesting José, very interesting! But let us think about the division in equal parts...". The second

reveals the reflective/interrogative teacher getting into a problematization process trying to recognize what happens in the confrontation between universalized mathematical knowledge and the contradictions that emerge from reality. One representative of this group/axis reaction: "If we take into account the contextualized knowledge of students like José and Luiz, are we contributing to a more meaningful learning of mathematics?". The third axe represents the teacher's beliefs, values, collectivity and power relationships, somehow related to the pedagogical practice. One of the teachers: "This is a terrible political issue... our students selling bubblegum at the traffic light... what are those children doing there?"

And, what have we learned from this ongoing research? How does this add to our understanding of the teachers' attitude issue of taking into account the "first knowledge" of students in a classroom?

I would say that my first comprehension of this process – from this research on - is directly focused on a process developed by the teacher – his/her **listening** – the development of his/her availability to listen to the student. As Freire points out, the teacher should develop an "opening to the speech of the other, to the gesture of the other, to the differences of the other, and (...) this does not mean, evidently, that listening requires from those who really listen his/her reduction to what the other speaks (...) this would not be listening, but self-effacement". (Freire, 1996, p. 135).

Listening to the students, according to Freire, is really, speaking "with" them, while simply speaking "to" them would be a way of not listening to them. And here is a great challenge: our **listening** as (mathematics) teachers. Usually, we, as teachers, educated by the so called traditional school, are not prepared to listen – and then, to speak "with" the other – once our teachers' pedagogical practices were almost always related to "**explanations**" or presentation of **questions already formulated by them**. In fact, as Freire & Faundez state, "the educator, in a general way, already brings the answer when nobody has asked him/her anything"! (Freire & Faundez, 1986, p.53).

The observation of these attitudes by the teachers – taking onto account the student's "first knowledge" and "listening" – became one of the aspects that we try to insert/explore/include in our investigations on (ethno) mathematical education and teacher education. In both cases, I believe I can declare that a lot of mathematics learning difficulties occur due to the lack of emotional and intellectual involvement of students in the preparation of the problems they solve. On the one hand, the teacher seems not to consider that the student, adult or child, has a conception of one aspect of knowledge that resulted from his/her learning history – first knowledge - and, it is this knowledge, as it is, that will do the filtering between

him/her and new knowledge. On the other hand, the issues that instigate the mathematical thinking action and that can lead to mathematical problems posing is not shown to the students. And then, if everything is defined and ready, how can what the students have to say about mathematics be important? Is it worth listening to them?

The second attitude to be developed in us, mathematics educators, when the purpose is to train teachers in order to take into account the student's "first knowledge" in a classroom, is to rethink with and among teachers **another notion of prerequisite** – like that knowledge that serve as filter/support to the learning of (new) ideas in mathematics.

In general, the idea of **prerequisite** traditionally employed in mathematical education is like a basis of logical order, indicated by the mathematician, as a *necessary* fact to the knowledge of the item to be studied. **Prerequisite** in this new vision refers to teacher's efforts in understanding how the student understands this or that (mathematical) idea, how he/she makes meaningful relations around a mathematical idea/content – how such mathematical knowledge is to the student... how he uses it, manages.

If we return, for example, to teacher Janaina's classroom and really take as a starting point the way the adult student Luiz uses the idea "every time that percentage appears I divide by ten and I add the times that it appears... like this... 30% I add three times, 40% I add four times..." (because somebody taught me so), we would have something valuable to start a meaningful process in terms of percentage. What would be necessary to be awakened to the teacher in terms of attitude? Naturally, even if it is a poorly elaborated attitude for us mathematics teachers, we should observe that from the information - acquired in social/familiar environment- what Luiz brings about the subject is full of memory, symbols and reasoning.

Luiz's intervention elucidate, somehow, the new meaning and role of what we have called pre-requisite, especially when we are in the field of action of mathematics teaching in primary school. The meaning is in showing/discussing the value of taking the knowledge the student already brings/manages/uses for the construction of mathematical relations traditionally expected by conventional school education.

From our point of view, the understanding of a new vision, by teachers, of **pre-requisite** – as what the student knows how to use, whatever logic/rationality and terms of this use – should be one of the aspects to be especially inserted/explored/included in the Ethnomathematical and Teacher Education investigations.

CONCLUSION

This article's intent was to look back at problems and solutions of the middle way between Teacher Education and Ethnomathematics, as well as put some problems for us to reflect about this possible interaction. Trying to reflect on such interface, I realized that we need to be alert to three important points – or three changing proposals.

The first is the fact that there are innumerable problem-situations and solutions from the non school context - which results in transit by different areas of knowledge and are validated/shared by experience – which the mathematics we learn in the school context does not allow us to notice, maybe due to our tradition of always valuing one kind of mathematics – the mathematics built at the academy, in general, free of contexts.

The second, directly linked to the first, when we notice such problem-situations as rich situations in terms of mathematics teaching, the construction of a *bridge* between this set of (mathematical) ideas and that one systematized by the school is in danger due to inter-relations between thinking and emotion, thinking and traditions, thinking and religion, thinking and the myths that lead to unexpected situations because of the tendency of language to take different meanings. In fact, for this *bridge* to happen it is, a lot of times, necessary a translation between the speeches by careful attention to meanings, to representations and, a lot of times, to linguistic elements.

Third, if our objective with a research of this kind is to develop a teacher education curriculum in which we problematize questions/processes that emerge from the student's socio-cultural reality, we recognize that the foundation for a research and/or a mathematics teacher education to act in this direction requires an incursion in literature focused not only on Mathematics, like in Anthropology, Sociology, History, Psychology and, specially, in the research production about Teacher Education in the educational field.

And finally it was possible to notice that preparing mathematics teachers to the development of the student's concerns and “first knowledge” is not incompatible to orienting them to teach mathematics – on the contrary, this can be one of the aspects to be developed in the teaching process.

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