DEVELOPMENT AND CONTEXTUALIZATION OF TASKS FROM AN ETHNOMATHEMATICAL PERSPECTIVE

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We propose incorporating an ethnomathematical perspective in primary school teacher education to facilitate a meaningful contextualization for the tasks they develop. We consider a meaningful contextualization from an ethnomathematical standpoint to be one that respects the studied culture from an emic approach, rather than an etic approach. We observe that studying cultural characteristics (Moroccan dishes in the examples provided) used as context seems to favor a better understanding and relation to the mathematical concepts that show mathematical complexity of the designed tasks, as far as developing the different components of the corresponding mathematical sense (sense of measurement in the analyzed cases).

INTRODUCTION

In this article, we put forward an introductory experience in Ethnomathematics involving a group of university students studying for a Bachelor of Primary Education. Such future teachers have a hard time contextualizing the tasks they develop for their students in a meaningful way and situating them in an environment close to that of the one the children live in. To do so, they have to get used to looking around and seeing mathematics in their daily experiences such that they can then incorporate these tasks creatively into their lesson plans.

We asked a group of prospective Primary school teachers to study cultural characteristics in their surroundings and later to contextualize these in tasks they develop. Using an ethnomathematical framework, this is a proposal for a research program focusing on mathematical practices of specific cultural groups, such as populations or guilds (Barton, 2008).

Context

At the Education and Humanities Department of Melilla, of the University of Granada, in the framework of a course called "Mathematical Education for a Bachelor in Primary Education", we proposed contextualizing the development of tasks from an ethnomathematical standpoint. In the third year of the Education degree future teachers have to develop a teaching unit and design tasks based on instructions from the Spanish curriculum such as mathematical conceptual teaching and learning tools taught in previous classes, specifically the concept of mathematical sense that will be described further on.

It should be noted that the city of Melilla has a unique history and geographical location. It is a Spanish city located on the coast of North Africa and with a surface area of approximately 12 square kilometers bordering Morocco on all sides. Historically the city has alternated between Catholic reigns (Duchy of Medina

Sidonia belonging to the Kingdom of Spain) and Muslim reigns (the Cordoba Caliphate connected to the kingdom of Al-Andalus), as well as being the sought refuge for Jews fleeing persecution on the Iberian Peninsula. Nowadays the city limits are those established in the 1860 Treaty which also states that it currently belongs to Spain.

This situation affects the fabric of society in the city. A little over half of the population is Muslim, and speaks *Tamazight Chelja*, a language that originally lacked a writing system. *Tamazight Chelja* is a Berber dialect from the Rif region, which geographically includes Melilla. It is worth mentioning that this language is not officially recognized by the Spanish organisms in the city. This part of the population, besides the language, shows other cultural characteristics typical of Berbers, as shown in their attire, cuisine and family structure.

THEORETICAL BASES

Background

A key idea in Ethnomathematics is that mathematics is a practice within and is part of a culture. Mathematics is the product of a socio-historical and cultural process that has evolved with contributions from different societies and cultures, which have built what we understand as mathematics today in a school context. Below, we describe our proposal of studying different ways of doing and looking at mathematics as a tool to delve deeper into the concepts that have been shaped throughout the construction of school mathematics. We value this practical mathematics as inspiration to improve the understanding of school mathematics and classroom practice. Investigating mathematics by looking at close cultural features or daily activities is something that was first proposed by Bishop (1991) and was carried out in practice by several authors.

When teaching future American teachers, Presmeg (1998) has them study a personal interest of theirs to later develop mathematical tasks. Gavarrete (2012), in a teacher training course in an indigenous setting in Costa Rica, suggested searching for mathematics in indigenous cultural characteristics to design contextualized tasks. Albanese and Perales (2014) worked on the development of mathematical tasks based on Argentinian folk dancing with a group of future teachers in Argentina. Finally, in Spain with a group of teachers in training, Oliveras (1996) proposed developing tasks based on Andalusian artisanship.

Mathematical sense and curricula blocks

The Spanish school curriculum (Ministry of Education, Culture and Sport, 2014) is based on a socio-constructivist theory of education and a functional focus of mathematics teaching in which learning takes places in a relevant context. Mathematics is considered to be a social construction and students construct the meanings of the concepts by structuring them and relating them to applications in different situations.

The development of a *mathematical sense* (the ability to use mathematics with sense) is the learning objective. In the same way that a curriculum organizes content into blocks, we can divide mathematical sense into four senses: number sense, spatial sense, sense of measurement, and stochastic sense (Flores and Rico, 2015).

The specific group of future teachers analyzed in this article focused their tasks on the sense of measurement, defined as "the identification of measurable attributes and characteristics, such as knowing, choosing and identifying units of measurement in different situations, be they conventional or nonconventional" (Rico y Flores, 2015, p. 45). They were expected to apply measurement strategies, and choose the most appropriate techniques to estimate.

Contextualization

Research into the mathematics of cultural characteristics or activities can be accomplished in two ways: an emic or etic approach (Rosa y Orey, 2012; Albanese, Adamuz-Povedano, and Bracho-Lopez, 2016).

In the emic approach, the vision of the cultural group being studied is taken into account and the categories and framework in that culture are respected. There is a broad and comprehensive understanding of what mathematics is, exemplified by the concept of Barton's QRS system (2008). That is to say mathematics is every "system for dealing with quantitative, relational, or spatial aspects of human experience" (p. 10).

In the etic approach, the researcher's point of view prevails and the analysis is carried out within the categories and framework of the researcher's culture. Here mathematics alone is considered the NUC system (Barton, 2008), the near-universal conventional system.

We deem contextualization of tasks meaningful if the point of view of the studied culture is respected from an emic approach. This means we consider that a task is contextualized if the situation created for the problem is consistent with situations that may effectively arise in a real context, and the mathematical concepts or procedures come into practice in the same way as the cultural group does.

OBJECTIVES

The objective of this research is to assess whether the participants developed mathematical tasks that were:

1) contextualized in a meaningful way;
2) suitable to develop the children's mathematical sense.

METHODOLOGY

At the end of the class, the students were required to turn in a final project, which makes up a large percentage of their overall grade. The project consists of a teaching unit that contributes to the development of one of the four mathematical senses listed above by means of three contextualized tasks.

Contextualization is based on an ethnographic approach to the chosen cultural characteristic. In the case of the analyzed group, that characteristic is Moroccan cuisine, in particular the couscous dish. The students interviewed Moroccan people who frequently cook this dish.

The analysis carried out here consists of:

1) determining if the contextualization of the task is meaningful in an ethnomathematical sense (emic) or not (etic).
2) Identifying which components of mathematical sense (in this case sense of measurement) the tasks work on.

For the sense of measurement we consider these components (Rico y Flores, 2015):

1) identifying measurable features
2) selecting units of measurement
3) doing measurement techniques
4) applying estimating strategies

RESULTS

The following is a detailed description of the analysis of two tasks developed by two students that focused on the same cultural characteristic: couscous[1], a traditional dish in Moroccan cuisine. As stated earlier, both respective teaching units were built around developing a sense of measurement.

Task 1

Below is the first task designed by student J.

M_J1: If 200 grams of couscous is needed to feed one person, would 1kg of couscous be enough for 4 people? How many people could 1 kg feed? How many bags would we need to feed 10 people? How many kilograms of semolina would we need to feed 15 people? If a 1kg pack of couscous costs 1 euro, and we use seven vegetables for each bag of couscous, if each vegetable costs 30 cents, and each plastic plate costs 15 cents, how much would it cost to feed 5 people? How much would it cost to feed 10 people? How much would it cost to feed 15 people?

This problem arose from a comment made during an interview with a cook when discussing how much couscous would be needed to feed a whole family.

The first part of contextualization follows the cook's customs and so is meaningful (emic), but later other factors do not, for instance using plastic plates (etic). The couscous is sold in packs of 1kg, so the cook calculates how many pack she has to buy, and how much money she needs to buy all ingredients. But there is a factor that does not respect the culture: couscous is usually served on a large platter set in the center of the table, and each person serves him/herself using a piece of bread (or a

1 A wheat semolina, cooked with steam, and usually served with different combinations of vegetable and meat.

fork). It is not customary to serve each person on an individual plate. So plastic dishes are not necessary. This task is useful for applying indirect measurement techniques, since it is not necessarily crucial to work with manipulative materials because it can be solved with mathematical operations. It is worth noting the use of different magnitudes, on the one hand weight and on the other cost.

Task 2

Below is the third task developed by student P.

M_P3: If 200 grams of couscous fit in a small water glass, how many grams of couscous would fit in a tall glass? How many would fit in a wine glass? How many would fit in a pitcher? How many would fit in a soup bowl? How many would fit in a ladle?

To carry out this task, the children are given a bag of couscous (usually sold in 1 kg packs) and the previously mentioned containers.

The contextualization of the task is meaningful (emic): in the interviews done by the students they described cooks using specific containers or cups to measure the quantity of couscous, water and oil to use. This means that the task respects the mathematical procedures that the cooks use.

From the point of view of the sense of measurement, this tasks means the children should develop estimating strategies to approximate the capacity of the different containers (component 4 of sense of measurement).

It also involves using different units of measurement, some which are conventional (grams and kilograms) and some which are unconventional (cups and containers).

It is interesting that this student proposed an estimation task, the likes of which are not usually found in Spanish text books, and the contextualization gave the student the idea of working with materials, in this case couscous which is easy to manipulate and preferable to using water, which is more commonly used for this purpose.

Below is a comparative analysis of all the tasks, not only the two described above (M_P3 and M_J1) but also those not analyzed in detail here. In the first row uppercase X represents meaningful contextualization (emic) in all aspects of the task, while lowercase x represents the tasks that contain some aspect in which the contextualization is not meaningful (etic).

Categories of Analysis/Tasks	M_P1 portions	M_P2 Nutritious recipe	M_P3 containers	M_J1 portions	M_J2 Recipe price	M_J3 purchases
Meaningful contextualization	X	x	X	x	X	X

Measurement system components	Relating measurable features		X		X		X
	Working with different units of measuremen t	X		X		X	X
	Measuring techniques	X	X		X	X	X
	Estimating strategies			X			

Table 1: Analysis of the tasks developed by the two students who focused on Moroccan cuisine.

FINAL REFLECTIONS

In almost all the tasks the contextualization was meaningful, at least in the general idea (except small details as the one mentioned above). From a mathematical perspective the tasks contributed to the development of a sense of measurement and had a certain degree of complexity, either because of relating different magnitudes or because they required estimating with direct measurements and comparing traditional and nontraditional units of measurement. Likewise we can point out that all the tasks involved more than one component of sense of measurement. This is further proof of their complexity. Such complexity is not present in most tasks developed by students who have not worked with cultural characteristics and thus have not pondered the use of mathematics in daily life, or at the very least have not delved as deeply as the students who developed these tasks did.

The interviews were an opportunity of encounter and dialogue "between cultures". The comments of the students relating the interviews to the cooks have been revealing in their progressive awareness of the cultural context of their environment, besides the mathematics involved. The cooks interviewed were the students' Berber housemaids who have little schooling. The students admitted that for the first time they were interested in the chores of these women who had almost reared them but about whose culture they did not know much.

A first challenge was represented by the increase of performance necessary to carry out the work. Fortunately the enthusiasm and motivation of the students has been the key factor to facilitate the realization of the whole project. Once the students were interested in their "cultural" discoveries, another challenge arises. It has been quite difficult to come back and focus again on the mathematics of the curriculum as the attention was dispersed on cultural elements.

We believe that the main implications of the experience for mathematics teacher education are:

1) to show how important it is to investigate first the context then to design tasks that are significantly contextualized.

2) to reinforce our hypothesis that studying mathematics in context allows students to reflect and deepen mathematical concepts (Albanese and Perales, 2014).

REFERENCES

Albanese, V., & Perales, F. J. (2014). Microproyectos etnomatemáticos sobre danzas folclóricas: aprender matemática desde el contexto [Etnomathematical microprojects about folkloric dances: learning mathematics from context]. *Profesorado, revista de currículo y formación de profesorado, 18*(3), 457-472.

Albanese, V., Adamuz-Povedano, N., & Bracho-Lopez, R. (July 2016). *Ethnomathematics: Two Theoretical Views and Two Approaches to Education*. Communication in the 13th International Congress on Mathematics Education (ICME 13). Hamburg, Germany. International Commission on Mathematical Instruction (ICMI).

Barton, B. (2008). *The language of mathematics: Telling mathematical tales*. Melbourne, Australia: Springer.

Bishop, A. J. (1991). *Mathematical enculturation*: A cultural perspective on mathematics education. Dordrecht, Holland: Kluwer Academic Pub.

Flores, P. & Rico, R. (Coord.) (2015). *Enseñanza y Aprendizaje de las Matemáticas en Educación Primaria*. [Teaching and Learning Mathematics in Primary Education] Madrid, España: Pirámide.

Gavarrete, M. E. (2012). *Modelo de aplicación de etnomatemáticas en la formación de profesores indígenas de Costa Rica [Model for the application of Ethnomathematics in indigenous teacher training in Costa Rica]*. PHD thesis in Education. University of Granada, Granada.

Ministry of Education, Culture and Sport (2014). Order ECD/686/2014, 23 April, which establishes Primary Education curriculum for the area managed by the Ministry of Education, Culture and Sport, and regulates its implementation, as well as assessment and specific organizational aspects [Educational law that establishes primary school curriculum]. Madrid, España.

Presmeg, N. (1998). Ethnomathematics in Teacher Education. *Journal of Mathematics Teacher Education, 1*(1), 317-339.

Rosa, M., & Orey, D. C. (2012). The field of research in ethnomodeling: emic, etical and dialectical approaches. *Educação e Pesquisa, 38*(4), 865-879.