The practice of chess players as a socio-cultural expression for research in ethnomathematics - a proposal in development

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ABSTRACT

Mathematical modelling and ethnomathematics are currently two topics that generate great interest in the research area of mathematics education, which is reflected in the growing number of scientific studies that deal with those topics in the last 10 years. Also, with the incorporation of modelling in the curriculum from a socio-cultural perspective and the need to incorporate mathematical modelling in initial teacher training, the aim of this research proposal is to show the ethnomodels of chess players, which can be incorporated into initial teacher training, in such a way as to broaden the teaching processes in the classroom. The methodology used will be a qualitative-ethnographic approach, developed in three stages: selection of the chess players, application of semi-structured interviews and thematic analysis of the data. It is expected to find some ethnomodels related to the precondition in the activity developed by the chess players, and thus, to propose learning situations that can be incorporated into the initial teacher training.

Keywords: Ethnomathematics, teacher training, Mathematical modelling, ethnomodelling

1. INTRODUCTION

Mathematical modelling is a line of research that has shown stability and development over the last decades, building a theory of teaching and learning in the domain of mathematical modelling [1]. Regional and global meetings have made it possible to identify new horizons around how the two primary concepts of reality and mathematics are related, understanding each of them with epistemological, didactic, philosophical and socio-cultural positions. In this regard, Henry Pollak, who is considered one of the pioneers in the field of applications and modelling in mathematics education, states that it is important to incorporate modelling and applications in the classroom, in order to motivate children and keep them interested in their learning process [2].

On the other hand, it is possible to identify the incorporation of modelling in the curriculum globally, where the literature mentions that modelling is embedded in the curriculum in Costa Rica, Vietnam, Germany, France, the Netherlands, Australia, the United States, Switzerland, Singapore and Chile [3-5], as well as in measurements such as PISA or TIMSS.

These impulses challenge mathematics teacher training schools to permanently update studies linked to the teaching of modelling, which has also been identified from the state of the art of research on mathematical modelling and teacher training, pointing out that this school activity is not only complex for students, but also for teachers. Therefore, preparing teachers to teach mathematical modelling is important during their professional training [6-9].

A central aspect of the teaching practice is the construction of tasks. Regarding mathematical modelling tasks, Kaiser and Sriraman [10] show 7 perspectives of mathematical modelling that are used for research in the area. Subsequently, and in agreement with these categories, the study by Blomhøj [11] carried out an analysis of all the mathematical modelling tasks in *Topic Study Group* 21 of ICME-11, whose categories identified were: Realistic, Contextual, Educational, Epistemological, Cognitive and Socio-critical, the latter being the one of interest for our study.

The modelling activities, from the socio-critical perspective, can be conducted in such a way that through mathematics the student manages to identify other ways of seeing the world in which he/she lives [12]. In this sense, the sociocultural dimension deepens and visualises the student as a learner in community, understanding the sociocultural as a way of explaining the relationships between human mental functioning and cultural, institutional and historical situations [13]. Therefore, Barbosa [14] proposes the possibility of reflecting on the role of mathematics in society on the basis of studies framed in the sociocultural dimension, in particular the critical nature of mathematical models in society, a

ISBN: 978-1-950492-77-0
ISSN: 2771-6368

https://doi.org/10.54808/ICSIT2024.01.24

central aspect being the relationship between the reality of this student and mathematics.

This research proposal dwells at the heart of the socio-critical perspective, with the aim of analysing how the cultural group of chess players makes use of ethnomodels in their work, in order to identify spaces for innovation in mathematics education, and specifically, in initial teacher training.

Next, key concepts of the study that will allow the analysis of ethnomodels are described, offering a review of the literature that allows its identification and the research question that directs the study. Subsequently, the research methodology is described, followed by a discussion of important aspects that support the feasibility and reliability of the study. Finally, the scope and future perspectives are described.

2. ETHNOMATHEMATICS

With respect to ethnomathematics, Ubiratan D'ambrosio [16], a precursor of ethnomathematics, states that there is a bridge that can unite mathematics and culture, characterising it as ethnomathematics, which he later defines as a research programme in which its main purpose is to propose a broader vision of knowledge and human behaviour, making sense of how different communities, societies and civilisations face their struggle for survival and transcendence within the different environments in which they are inserted: environmental, cultural, economic and social [16]. Due to the above, the author points out that the main guide for his research in ethnomathematics corresponds to identifying the modes, styles, arts and techniques generated and organised by different cultural groups to learn, explain, understand, do and face their natural, social and cultural conditions [17].

In studying the relationship between modelling and the socio-cultural, Villa-Ochoa et al. [15] through the analysis of nine articles on the different socio-cultural approaches to modelling, highlight the contributions from socio-epistemology, ethnomathematics and a critical and socio-political perspective of mathematics education, and ethnomodelling.

Rosa and Orey [18] define ethnomathematics as the intersection between three concepts, namely cultural anthropology, mathematics and mathematical modelling, which will help students understand and connect diverse mathematical ideas and practices between what is lived in their communities and academic mathematics. These authors interested in modelling and its incorporation into teaching processes and ethnomathematics, define a new concept they call ethnomodelling as a practical application of ethnomathematics, which also considers the cultural perspective to modelling concepts that lives in communities [19]. Also, Desai et al. [20] state that the combination of mathematical modelling and ethnomathematics approaches, known as ethnomodelling, allows for more engaging experiences that are rich in mathematical content and are culturally sensitive to students' backgrounds, cultures and identities. Similarly, Rosa and Orey [18] state that the main aspect of ethnomodelling is to solve everyday life problems, so that students can understand better and more about the importance of mathematics in their society and context.

Rosa and Orey [21] state that within ethnomodelling three components can be identified: the emic approaches corresponding to the local, the etic and the emic-etic corresponding to the Glocal - dialogic, where the EMIC is concerned with the view of how one has come to develop mathematical ideas and procedures while respecting the cultural practices, social understandings, customs, among others, that members of different cultural groups describe of their own culture within their own terms. EICT is concerned with an outsider's view of the scientific and mathematical beliefs, customs and knowledge developed by members of different cultures, describing similarities and differences in cultures through the use of descriptions, analyses, ideas, procedures and schemes that scientific observers consider meaningful within the community. And EMIC-ETIC represents a continuous interaction between globalisation (ETIC) and localisation (EMIC) where it offers a perspective in which both approaches develop elements of the same perspective related to the same phenomenon. Also, Rodriguez et. al. [22] state that ethnomodelling can be understood as the dialogue that exists between the ethical approach, which corresponds to ethnomathematics, and the ethical approach, which corresponds to mathematical modelling.

Within ethnomodelling, the process of ethnomodelling is defined as the study of ideas and procedures that are used in mathematical practices that are developed by members of different cultural groups, and the concept of ethnomodels corresponds to cultural artefacts that can be taken as internal (emic) or external (etic) representations of everyday phenomena that are consistent with socially constructed mathematical knowledge shared by members of different cultural groups through dialogue.

In this study, the cultural group corresponding to chess players has been selected, since the state of the art shows that there are different research studies that focus on explaining the contributions that chess can provide in the teaching of mathematics and propose activities that can be incorporated as a tool for teaching mathematics [23-25]. However, this study differs from the above, since, based on ethnomodelling, this study is interested in knowing the ethnomodels that are developed by chess players when playing chess, so that students can understand about mathematics in society with applications in the classroom that also favour the learning

of this discipline through teachers in training. In summary, the question guiding the present research is: What are the ethnomodels that are possible to evidence from the cultural group of chess players that can be incorporated into teacher training in order to promote an improvement in the teaching-learning process in the mathematics classroom?

3. METHODOLOGY

This study will be carried out from a critical paradigm, from a qualitative approach with a postmodern transformational interpretative framework with an exploratory-descriptive scope.

To carry out this research, 3 phases will be carried out, which are based on the specific objectives of the research, in order to respond to the general objective set out in this project. Phase 1 corresponds to know the mathematical knowledge produced and disseminated by the cultural group of chess players and phase 2 to know the ethnomodels constructed by the chess players from their own practice and phase 3 to characterise the ernomodels constructed by the chess players from their own practice.

In phases 1 and 2, the data collection will be carried out from an ethnographic study, which corresponds to a complete or partial description of a group or village, which is focused on a group of people who have in common, in this case, the farming community. José & Rica [26], however, highlight that in the description of each of the phases the design, as in all ethnography, is flexible and is generated in situ, the interest is in the native point of view and the tacit or implicit part of the cultural knowledge that affects behaviour and communication [27]. Below is a detailed outline of the phases, including key informants, the data collection technique, the information to be collected, how the data analysis will be conducted, validation processes and important ethical issues to consider:

Table 1

Methodological elements of the research (Prepared by the authors)

Research phase	Key informants	Data collection techniques	Information to collect	Ethical aspects
Phase 1: "selection of participants"	Chess players	Non-participant researcher. Field diary.	Mathematical knowledge involved in your practice as a chess player.	Written informed consent from each study participant.
Phase 2: "semi-structured interviews"	Chess players	Semi-structured survey	Ethnomodels involved in your practice as a chess player.	Written informed consent from each study participant.
Phase 3: Thematic analysis of the data.	-	-	-	-

The breakdown for the selection of participants will firstly involve a non-participant observation in the chess club in Chile, located in Santiago of Chile, the purpose of which will be to understand the way in which the group or person experiences, defines and signifies their personal reality within their activity, in order to define the possible questions regarding their practice or problem of study [28]. At this stage, the chess players will be told about the research to be carried out and will be asked to participate in it, and it is hoped that 3 to 5 players will decide to participate voluntarily, and then in the second phase, semi-structured interviews will be carried out. At this stage, participants will be asked to sign a written informed consent form to confirm that their participation is voluntary.

The analysis of the data will be carried out by the researchers, and will be based on the articulation of two methods of analysis proposed by Rodríguez et al. [22], namely the thematic analysis, whose method allows for the identification, analysis and reporting of patterns within the data, which is carried out in 6 phases: 1) familiarisation with the data, 2) generation of initial codes, 3) search for themes, 4) review of themes, 5) definition and naming of themes, and 6) production of a report. This method is combined with the analysis carried out by ethnomathematics, where D'ambrosio [17] points out that observation and analysis must be carried out in order to describe and understand the practices of cultural groups.

4. DISCUSSION

The present study is in a process of adjustment, both in the characterisation of the problem and in the methodological aspects, which at the moment have been well aligned. To continue the research, it is necessary to consider the following aspects of relevance, which we consider to be key for a successful development:

- It is necessary that there is an important immersion on the part of the researchers in the study community. For this, ethnographic techniques can be useful for a characterisation of the practice of the chess community.
- Sequentially, it should be possible to identify a certain practice of the chess community with some mathematical concept or idea, which we initially assume to be patterns, since the practice of the chess player considers the multiplicity of pieces from rigid movements to be paramount. Therefore, we consider that to achieve the objectives of this board game, it is necessary to recognise types of patterns within a Euclidean planar geometry. This scenario does not rule out the notion of visualising the distance with norm 1 (commonly known as the taxi distance) for the analysis. These and other types of decisions

need to be considered in the development of ethnographic data analysis.

- One of the key aspects that allows chess players to develop their practice is prediction. In this respect, there is a variety of literature from the socio-critical perspective that has analysed how prediction acts as a way of constructing mathematical knowledge. In this respect, Cantoral's work [29] considers prediction as a social practice that encourages the construction of mathematical models and ideas to achieve an objective, in this case, winning at chess.
- Several works in the area of ethnomathematics consider a key factor to be able to relate the emic with the etic, which from a mathematical modelling perspective (and in the sense of Rosa and Orey [30]), is to establish the dialogic from a linguistic perspective of ethnomodelling, or what [22] has called connection. In this way, it is possible to define a dialogue between the institutional and traditional mathematics of the school and the mathematics of the chess community. Thus, the present work admits, at least, two valuations of interest: 1) the enrichment of ideas in the teaching of mathematics, in such a way as to broaden the forms that mathematical objects have from communities, and 2) the valuation of human practice from an epistemological approach.

5. FUTURE PERSPECTIVES

Finally, and after having carried out an exhaustive review of the literature on ethnomathematics articles, the expected results point preferably in two directions. The first has to do with the identification of mathematical ideas that are used by the cultural group of chess players, which offers a sense and meaning to mathematical ideas, and it is of interest to identify the epistemological connections with traditional mathematics. This first part is the identification of the ethnomodels.

A second direction of the expected results concerns how it is possible to include such a sense and meaning of mathematical ideas used by chess players in initial teacher education. In this way, it is hoped that future mathematics teachers will be able to innovate, through the construction of didactic situations, in the range of uses of such mathematical notions, in such a way that it can have an impact on their professional teaching practice.

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