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Filippo Spagnolo
Benedetto Di Paola (Eds.)

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Preface

Recently, mathematics educators have shown enthusiasm about conducting comparative studies involving East Asian countries, primarily because students of East Asian, such as Chinese students, show outstanding performance in various international assessments. Culture, teachers' knowledge, instruction, curriculum, and assessment have been identified as factors contributing to the achievement gap in various studies. However, the authors in this book argued that cognitive processes in the socio-cultural context play an important role in the differences in student mathematics learning. They analyzed the cognitive processes based on the comparison of Italian and Chinese cultural contexts both in historical and in epistemological aspects.

The investigation of the nature of the difference in student learning between Italy and China is the focus of this book. For so many years, international comparative studies in mathematics education focused on the difference in external aspects in student learning, and less attention was on the differences in the linguistic language structure in a socio-cultural context. The authors of this book broke new ground by contributing to a better understanding of how Chinese students acquire algebraic reasoning from an epistemological and linguistic aspect. By thoroughly examining the representative text of ancient Chinese mathematics culture (*The Jiuzhang Suanshu, Nin Chapters on the Mathematics Art)* and investigating the linguistic structure of the Chinese written language, the authors identified differences in the hierarchies of the reasoning models generally used by Chinese students and Aristotelian-Euclidona mould by Italian students in five experimental situations. The deeper study of the Chinese cultural origin led to an analysis of historical aspect of mathematics and specifically the evolution of algebraic thoughts over the different cultural traditions.

Notably, both qualitative and quantitative methods were well-employed in this study. The instrument was well-designed based on the purpose of this study and based on European and Chinese cultural and historical contexts. The authors used a great deal of effort on the data collection which used multiple sources, such as survey and semi-structured interviews, documents, observations, to enhance the validity of the design. The five sessions of the research experiments were sequential, building upon one another. Cohesive hierarchical implicative classification was used appropriately for quantitative analysis of experimental data.

The analytical narrative and discussion in the presentation focused on the diversity of cognitive styles, solution strategies, and learning methodologies as opportunities in mathematics. The book provides an excellent model in which it identifies linguistic, historical, neuro-scientific, psychol-lingusutic, and the didactic aspects in study of acquisition of algebraic competences in mathematics for the

students as it is shown in discussion and analysis of the Chinese particular system of graphemic fixation and specific characteristics of Chinese writing. The charts and tables of the participant demographic information were very helpful and informative, and the statistical illustration in writing used various figures and tables, which organizes the information of the study in a visually meaningful way and provides readers with a deep understanding of the study.

The authors used rigorous and unique methods to analyze and draw conclusions from the data by structuring data analysis in different types and chapters. More commendable, treating cultural diversity as an opportunity in mathematics by deeply studying Chinese mathematics from the arithmetic to the algebraic content in the historical aspect-cultural puzzle, is excellent approach in culture-related studies.

The book provides strong evidence that research on the cognitive processes, from arithmetic thought to algebraic thought, should take into consideration the socio-cultural context. It is an important contribution to the literature on linguistic structure in comparative studies related to Chinese student mathematics learning.

This book not only makes a great contribution to research in mathematics education, but the findings of this study also addressed insightful approaches and thoughts of understanding the development of algebraic thinking in cultural contexts for classroom teachers. Using written Chinese language from different theoretical references provided wonderful approaches for understanding student algebra cognitive development in a different way and calls educators to pay special attention to an epistemological and linguistic view of algebraic development. The findings inform classroom teachers that the cultural context plays an important role in student learning mathematics. A typical analysis of the cognitive dimension involved in some in the historical and cultural contexts is a great resource for classroom teachers.

I really enjoyed reading this book and learned a lot from its compelling analysis. I am fascinated by the topic and the method of analysis of data from historical and cultural perspectives. The authors' efforts in investigating student cognitive process from arithmetic to algebraic are extraordinary, especially the connection to linguistic, historical, the neuro-scientific, psycho-linguistic, and the didactic aspects. This study is very valuable to the mathematics education field and a remarkable contribution to international related studies.

As a Chinese scholar, I admire Dr. Benedetto Di Paola's brilliance in investigating the relationship of Chinese linguistic structure and student algebra thinking. I greatly appreciate his hardwork and excellent contribution to the mathematics education field. Special thanks go to Dr. Filippo Spagnolo's great effort and dedication to the mathematics education field and his wisdom of advice and support to Dr. Benedetto Di Paola's research relating Chinese culture and language. Their team has been very successful and fruitful.

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Introduction

The increase of different culture pupils represents, for the last decade, the greatest novelty in the Italian school. This growth will probably be constant for the next future.

After a first period of simple notation of the situation, the Italian scholastic system and, inside of it, the teachers begun to warn the necessity to intervene and, consequently, to consider the possibility to foresee actions that kept in consideration the change of the cultural context, but also the social one, of the classroom.

In the large majority of the cases, these actions are shaped in the form of training in-service courses on general themes of the interculturality and the intercultural pedagogy for the teachers. Parallelly, absolutely inevitable, different initiatives of teacher training to the didactics of the Italian language as second language, were made.

For many years, the presence of different culture pupils in the classes was considered as a "problem" regarding only the general pedagogy, for the teachers, and regarding the language, for the pupils. Namely, the people thought that, it was not necessary for other things except to furnish these tools that are essentially communicativeness.

The reality of the classroom shown and still now show how this assumption was and is enormously wrong. It shown this to the most careful teachers and to the ones that, for different reasons, warned only recently the "problem". Among these last ones we have to include almost the totality of the mathematics teachers!

The assumption that the "problem" of the presence of different culture pupils in the classroom and the "problem" of the multicultural classes are, exclusively, a problem of communication is nearly found on the belief of the teachers that, from one side, a specific subject is a "corpus" rigidly structured in their contents and in their formality of transmission and that, from another side, the socio-cultural background of the student does not influence, in general, his learning process if not for what it achieves from his not complete or scarce knowledge of the vehicular language, or from the different level of schooling with which he entered the classroom.

This assumption is very rooted among the mathematics teachers, from the great majority of the teachers who see the subject taught as a "universal language" and "culture free", and so not determined and conditioned, also in its contents, from the culture of the different societies.

The research works of D'Ambrosio, since the first years 1980, and the research works of Bishop, from the beginning of the second halves of the same years, clearly shown instead as such reading and vision of the mathematics are to be considered limitated because they essentially reduce the mathematics to a complex of

notions and knowledge that are transmitted in a scholastic ambit. Complex of notions and knowledge that, even if it is vast and remarkable from the academic point of view, it cannot be considered as comprehensive of all the mathematical knowledge, presented in various forms and used in different social and cultural contexts, also not scholastic. Correctly, D'Ambrosio and Bishop have shown instead, even though with different approaches, that we have to speak of mathematics or in a better way of mathematical activities, rather than of mathematics.

If it is accepted then to consider the mathematics as a complex of activities (to count, to measure, to locate, to draw, to play, and to explain), we see the mathematics as a cultural product, gotten by the exercise of such activities. On the other hand, even if such activities can be sights how common to all the societies as categories, they often differ themselves in their formalities of carrying out. In effects, these differences are not only revisable when very distant society (macro-cultures), are observed in their complex system but also when single societies are analyzed (micro-cultures).

A reading in cultural key of the mathematics inevitably asks a more punctual analysis on the single societies has developed their own cultures. It is necessary to keep in mind of different factors, beginning from the principal ones in anthropological ambit, historical ambit, linguistic ambit, religious ambit, and technological ambit.

These factors are integral part of a culture, that produces them and it is developed from them, in a continuous process. They are also integral part, therefore, of a correct and complete analysis of the mathematics, as cultural product. To these factors it is necessary to refer, therefore, also when we intend to examine how the mathematical knowledge is transmitted and receipted inside one determined society or social group.

Without doubt and meritoriously, Filippo Spagnolo and Benedetto Di Paola worked in this direction in their work of analysis and comparison, as specifically regards the phase of teaching/learning of the mathematics of two different cultural realities as Italy and China, so differ among them.

The deep difference of these two cultures is also warned evidently in clear way from the teacher, who often see these represented more and more and in meaningful way in his/her own classroom. Such difference often means, also for the teacher of mathematics, an element of difficulty in comparison to the use of the usual didactic methodologies. A teacher of mathematics, aware of this difficulty, will find in this research work elements of knowledge and sprouts of reflection that should allow them to better facing the novelty of the didactic intercultural situation. Reality in which they operate and to make more profitable, for the whole class, the process of teaching /learning of the mathematics subject.

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