MENTAL ARITHMETIC AND MATHEMATICAL SKILLS IN PRIMARY SCHOOL. A COMPARATIVE PERSPECTIVE BETWEEN TWO POST-COLONIAL EDUCATION SYSTEMS: MARTINIQUE AND SENEGAL

CALCOLO MENTALE E COMPETENZE MATEMATICHE NELLA SCUOLA PRIMARIA. UNA PROSPETTIVA COMPARATIVA TRA DUE SISTEMI SCOLASTICI POST-COLONIALI: MARTINICA E SENEGAL

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Double Blind Peer Review

Citazione

Garcon M.P.E., Alì M., Cruz R., F., Nicar N.A., (2023) Mental arithmetic and mathematical skills in primary school. A comparative perspectives between two post-colonial education systems: Martinique and Senegal, Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva - Italian Journal of Health Education, Sports and Inclusive Didactics. Anno 7, V 2. Edizioni Universitarie Romane

Doi:
https://doi.org/10.32043/gsd.v7i2.877

gsdjournal.it
ISSN: 2532-3296
ISBN: 978-88-6022-470-5

ABSTRACT
Several research studies have suggested that negative social representations associated with mathematics have an impact on school performance. These representations are the product of a culture, develop within a learning ecosystem and are dependent on the socio-economic context. In some post-colonial territories, for example, they have been shaped by prejudices and stereotypes inherited from the colonial past. This article presents the results of a study conducted among primary school pupils in two postcolonial contexts, Senegal (N=2973) and Martinique (N=2710) using a psychometric tool, the *Test de Repérage des Difficultés en Mathématiques*.

ABSTRACT
Diverse ricerche hanno suggerito che le rappresentazioni sociali negative associate alla matematica hanno un impatto sul rendimento scolastico. Queste rappresentazioni sono il prodotto di una cultura, si sviluppano all'interno di un ecosistema di apprendimento e dipendono dal contesto socio-economico. In alcuni territori post-coloniali, ad esempio, sono state modellate da pregiudizi e stereotipi ereditati dal passato coloniale. Questo articolo presenta i risultati di uno studio condotto nelle scuole elementari di due contesti postcoloniali, il Senegal (N=2973) e la Martinica (N=2710), utilizzando uno strumento psicometrico, il *Test de Repérage des Difficultés en Mathématiques*.

KEYWORDS
Didactics of mathematics, Martinique, Mental calculation, School difficulties, School performance

PAROLE-CHIAVE
Calcolo mentale, Didattica della matematica, Difficoltà scolastiche, Martinica, Risultati scolastici.

Introduction

The relationship between socio-cultural contexts and mathematics learning has been deeply explored since the second half of the 20th century, especially in the framework of an emerging field of research, the ethnomathematics (D'Ambrosio, 1980; Ascher & Ascher, 1986). Mathematical skills are often described as a gateway to succeed in life; nevertheless, for too many students, academic success in this area is often elusive, especially within communities that, due to their socio-economic situation, have been historically marginalised (Adelman, 2009; Halai *et al.*, 2016; Chronaki *et al.*, 2019). Some authors consider that the low achievement of these students is due to the fact that, in such contexts, mathematics is often taught in a way that is disconnected from their socio-cultural environments (Harding, 1998; Martin, 2000) and that the methodological foundations of the discipline, as articulated in school curricula, remain essentially Western-led (Rosa and Orey, 2011).

To take part in this discussion, this article presents the results obtained in the framework of the research project *Train to teach, to calculate mentally: a comparative perspective from Senegal and Martinique and the construction of teacher training*[1]. The primary objective of the project was to test the mental calculation skills of primary school pupils in post-colonial environments, but also to understand their mental construction of the concept of number and its numerical representation. It was based on a comparative analysis of two territories, which were once subject to the same imperial power (the France Empire) but which have undergone different decolonization processes: Senegal (an autonomous country that has been independent of France since 1960) and Martinique (an overseas department that has been administratively integrated to France since 1946). The secondary objective of the project was to develop and propose ways of improving pupils' performance in mental arithmetic based on participatory work involving Franco-Senegalese teams to build teaching tools adapted to local needs and cultures.

[1] Also known by its short title in French, *Calcul Mental Africa2020*, the project is led by the Institut National Supérieur du Professorat et de l'Éducation de Martinique (Université des Antilles, France), and funded by the *Saison Africa 2020*, an initiative of the President of the Republic implemented by the *Institut de France*, an operator of the French Ministry of Europe and Foreign Affairs and the Ministry of Culture.

The results obtained enabled us to specify the objectively measurable level of primary school pupils in the field of mental arithmetic but also to better understand the role of context in the construction of mathematical knowledge.

1. The research process: research problem, methodology and study population

The teaching methods of mathematics practised in Martinique and in Senegal are the subject of close observation because of their development, but above all because of their effectiveness in the field of mental calculation. The educational policies of each of these territories have invested in establishing new curricula and making recommendations to optimise and develop existing practices. This is also reflected in the introduction of the Malaysian Universal Concept of Mental Arithmetic Systems programme in some Senegalese schools for children aged 5 to 15; while in France the Ministry of Education, Youth and Sports has strongly recommended for several years that the sense of numbers and operations as well as the development of automatic calculation skills be ritualised from the earliest grades, in this case, from nursery school (MENJS, 2018).

To investigate the performance of Martinique and Senegal primary school pupils we used a psychometric tool, the *Test de Repérage de Difficultés en Mathématiques* (TRDM) developed by Sandrine Mejias, Claire Muller and Christine Schiltz (2019). It is a tracking tool built from a social-cognitive approach that has already been validated by other scientific studies (Georges et al., 2021; Ghazali et al., 2021; Martini et al., 2021). The TRDM contains tasks whose difficulty is adapted to each school level: dictation of numbers, comparison of numbers (integers, decimals, fractions), rapid resolution of written operations (arithmetic fluency). This last test is timed and must be completed within a limited time (1 minute per operation). The instructions are given orally by the examiner and, at the time of evaluation, one point is awarded for each correct answer. To facilitate the study of correlations, the scores obtained by the participants were listed anonymously in an Excel™ spreadsheet according to the participants' school, grade, gender, and examiner. The results obtained through the large-scale deployment of the TRDM allowed us to identify not only the average performance of students according to certain variables but also the best performances, to determine the rate of students who obtained the highest scores in each test.

The population of our study is made up of pupils enrolled in public and private primary schools located in the region of Thiès for Senegal (N=2973)[2] and of public

[2] The research corpus is freely accessible from DOI: 10.17632/7vm4x2b7hw.1 (Garçon, 2022).

primary school pupils spread throughout the island of Martinique (N=2710)[3]. As the gender distribution of pupils in Martinique was not available from the statistical services concerned, we chose to divide our sample equally between girls and boys (Table 2).

Gender	Total number of pupils	Proportion in relation to the sample
Girls	1261	49%
Boys	1331	51%
Total	**2710**	**100%**

Table 2: Distribution of the sample by gender in Martinique

As for the gender distribution of pupils in the Senegalese sample, it is consistent with that of the region (*Inspection d'académie de Thiès*, 2021. Table 3).

Gender	Total Number of pupils	Proportion in relation to the sample	Proportion in relation to the study population
Fille	1509	51%	52%
Garçon	1464	49%	48%
Total	**2973**	**100%**	**100%**

Table 3: Distribution of the sample by gender in Senegal

We chose to distribute our sample with the same proportion of pupils per type of schooling to guarantee, once again, the statistical representativeness of our study. In Martinique, the 32 schools we tested are spread over 10 school districts. The department has 50 schools in the *Réseau d'Éducation Prioritaire Renforcée* (REP+, High Priority Education Network, hosting the 23% of island pupils), 65 schools in the *Réseau d'Éducation Prioritaire* (REP, Priority Education Network, from which 29% of the island's primary school pupils are drawn), and 107 not-priority schools (HEP, 48% of pupils. *Académie de Martinique*, 2021. Table 4).

Schools types	Total number of schools	Proportion in relation to the sample	Proportion in relation to study population
REP	802	31%	29%
REP +	512	18%	23%
HEP	1341	51%	48%
Total	**2710**	**100%**	**100%**

Table 4: Distribution of the sample based on school type in Martinique

[3] The research corpus is freely accessible from DOI: 10.17632/j9yfh482r4.1 (Garçon, 2022).

In Senegal, the focus was on the type of school, private or public. The 11 schools from which the students in this study came are spread throughout the Thiès district, which counts 988 public schools (about 79% of pupils) and 258 private schools (about 21% of pupils. *Inspection d'académie de Thiès*, 2021. Table 5).

Schools types	Total number of schools	Proportion in relation to the sample	Proportion in relation to study population
Public schools	2258	76%	79%
Private schools	715	24%	21%
Total	**2973**	**100%**	**100%**

Table 5: Distribution of the sample based on school type in Senegal

In parallel to this main study, we also carried out a complementary survey with a small sample of our study population (89 primary school pupils in Martinique and 470 primary school pupils in Senegal). The questionnaire consisted of six questions on mathematical activities in the family environment (to identify the habits and tools used by families) and on attitudes towards mathematics and mental arithmetic (to detect the mental representations of children). Although the sample for this secondary survey is not statistically representative, the analysis of the children's responses allows us to interpret the results of our main study, particularly to explain certain statistical trends and inconsistencies. In addition, this approach has provided a better understanding of the relatively strained relationship that students have with mathematics and mental arithmetic.

2. Pupils' performance

The *Test de Repérage de Difficultés en Mathématiques* (TRDM) allowed us to identify the average skills of the pupils surveyed in four basic areas:

- Dictation (which assesses pupils' ability to associate a number correctly with its numerical representation);
- Comparison of quantities (which assesses pupils' ability to identify two quantities, to associate them with the corresponding numbers and to position these numbers correctly on a scale of sizes);
- The resolution of numerical complements (which corresponds to the basic cognitive mechanism necessary for mental calculation);
- Rapid calculation (which requires both speed of execution and precision but also the ability to control the result).

The first three areas constitute the first part of the test, which is devoted to number construction, while the second part is limited to the speed test.

The TRDM was administered in classrooms during school hours in the presence of a teacher and one or more researchers associated with the project[4]. Each student was asked a series of questions adapted to his or her age and school level, following the instructions and procedures provided by the TRDM developers[5].

All domains combined, the average total score of the pupils who took part in our study ranged in Senegal, depending on the level, from 50% (for CE2 level[6]) to 58% (for CP level[7]) of correct answers. In Martinique, the average total score of the pupils who participated in our study varies from 19% (for CE2 level) to 27% (for CM2 level[8]). These initial results raise questions: indeed, the test designers suggest that scores between 7% and 30% are often associated with difficulties arising from a lack of investment in mathematics activities (at school or at home). In contrast, at the general level but also after a domain analysis, our study did not reveal significant differences between the performance of girls and boys.

The first part of the test was better passed in Martinique by first graders (86% correct answers), while those in second and third grade had an average score of 54% and 68% respectively. We also observed that CE2 pupils were more successful overall in the number comparison exercises - than those assessed based on number dictations - and obtained the lowest score for the calculations of complements to a number (to 10, 100 and 1000).

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[4] Some of the test-taking sessions were recorded by a team attached to the *Division de la Radio-Télévision Scolaire* (DRTS/Senegal), a public operator of the national Ministry of Education in charge of producing and publishing educational resources and a partner in our project. These recordings will then be used for the development of study and teaching resources that will be broadcast in France and Senegal.

[5] We collaborated with the designers of the TRDM to create a version of the test adapted to the territories of Martinique and Senegal. The starting point was to design an assessment that would cover the common parts of the official curricula of both territories. Optimisation work was carried out with the *Mission Mathématiques 1er degré of Martinique* in order to find a form of the test (layout of the questions, size of the characters, presence of images, etc.) close to the national assessments and guaranteeing a good context for the test.

[6] CE2 is the third grade of primary schools and corresponds to a 7–8-year-old student.

[7] CP is the first year of primary schools and corresponds to a 5–6-year-old student.

[8] CM2 is the fifth and last year of primary schools and corresponds to a 10–11-year-old student.

On the other hand, the results of this first part of the test are rather homogeneous for Senegal. Indeed, apart from the CE2 level, which obtained 69% of correct answers, the four other levels presented results of between 73% and 74%. It would seem, in fact, that the rate of acquisition of skills in number construction is rather regular. We also observe a surprising phenomenon concerning number dictation and number comparison. We can consider that dictation and knowledge of numbers is a prerequisite for comparison. However, for the CP, CE1[9] and CE2 levels, the percentage of correct answers is higher for the comparison than for the dictation. This trend is reversed in CM1[10] and CM2, with better results in dictation than in comparison, which is what we expected. We also observed that CE2 pupils were more successful overall in the number comparison exercises than in the number dictation exercises, and that they obtained the lowest score for calculations of complements to a number (to 10, 100 and 1000).

It is precisely around complements that the pupils participating in our study obtain the lowest scores. The average score of CM1 pupils is 38% of correct answers and that of CM2 pupils 44% in Martinique, while that of CM1 pupils is 64% of correct answers and that of CM2 pupils 63%. It would also seem that the rate of acquisition of number construction skills is not similar in the populations studied. We observe an irregularity in one group, while the other group shows a palpable regularity. In short, this means that the average pupil leaves primary school and enters secondary school with an insufficient mastery of basic calculation skills in our two post-colonial populations.

On the other hand, the second part of the test, devoted to rapid calculations, was much better performed by the CM2 pupils for the whole sample (Tables 6 and 7), with an average score of 91 operations performed in 4 minutes in Martinique and an average score of 51% of operations correctly performed in Senegal. The following tables show the correct answers obtained for each of the four operations. As a reminder, the students had one minute for each of the operations: addition, subtraction, multiplication, and division. As might be expected, addition was the operation best mastered at all levels.

However, the scores obtained in operations requiring the use of division are clearly lower, in all school levels (between 7% in CE2 and 13% in CM2 in Martinique and between 17% in CE2 and 32.5% in CM2 in Senegal). This leads to the observation

[9] CE1 is the second year of primary schools and corresponds to a 6–7-year-old student.
[10] CM1 is the fourth year of primary schools and corresponds to an 8–9-year-old student.

that there is a gradual and moderate increase in rapid calculation skills throughout a pupil's schooling in primary school.

As regards the exercise of rapid calculations within the island population, we also wanted to record the highest scores, in order to detect the presence of pupils with exceptional performance: the highest score in absolute terms was obtained by a pupil in CM1 with a score of 98 correct multiplications within the time allowed. For comparison, the highest score in the division domain was obtained by a pupil in CM2 who performed 61% of the operations correctly and within the time limit. As the table shows, first graders were not tested in this second part of the test.

	Averages				
	CP	**CE1**	**CE2**	**CM1**	**CM2**
PART 1 (construction of a number)	***Average number of correct answers***				
Number dictation	97%	84%	84%	89%	87%
Number comparison	88%	92%	91%	84%	81%
Complement to a number	79%	52%	30%	38%	44%
Sub-total part 1	**86%**	**68%**	**54%**	**58%**	**61%**
PART 2 (speed calculation)[11]	***Average number of correct answers***				
Additions		42,5%	52,5%	65%	80%
Subtractions		30%	42,5%	52,5%	65%
Multiplications		20%	35%	40%	53,5%
Divisions			17,5%	20%	32,5%
Sub-total part 2		**31%**	**37%**	**44,5%**	**58%**
Total array	86%	42,2%	41,2%	47,8%	58,7%

Table 6: Results of the mental arithmetic test by level in Martinique

The observation of the results according to the typology of the school of enrolment reveals significant differences. Indeed, the first part of the test was better passed by schools located outside the priority network for islanders in Martinique. It is the schools located in REP that have the best performance in rapid calculations. Schools in REP+ remain at the bottom of the table for both parts of the test (Table 7).

	Averages		
	HEP	**REP**	**REP +**
PART 1 (construction of a number)	***Average number of correct answers***		
Number dictation	89%	85%	80%
Number comparison	89%	85%	83%
Complement to a number	47%	36%	28%

[11] Pupils in CP did not take the rapid calculation test

Sub-total part 1	**65%**	**65%**	**65%**
PART 2 (speed calculation)	***Average number of correct answers***		
Additions	57,5%	70%	55%
Subtractions	47,5%	52,5%	42,5%
Multiplications	37,5%	45%	30%
Divisions	25%	25%	15%
Sub-total part 2	**40%**	**47%**	**34%**

Table 7: Results of the mental arithmetic test per school type in Martinique

In Senegal, we observed better performances in private schools (Table 8).

	Averages	
	Public	**Private**
PART 1 (construction of a number)	***Average number of correct answers***	
Number dictation	79%	91%
Number comparison	80%	88%
Complement to a number	51%	61%
Sub-total part 1	**67%**	**77%**
PART 2 (speed calculation)	***Average number of correct answers***	
Additions 1 minute	54%	65%
Subtractions 1 minute	35%	51%
Multiplications 1 minute	44%	44%
Divisions 1 minute	24%	27%
Sub-total part 2	**39%**	**47%**

Table 8: Results of the mental arithmetic test per school type in Sénégal

The results we have obtained help us to confirm and clarify the observation suggested, before us, by other researchers who have investigated the Senegalese territory, but also by those who have worked on the West Indian context, namely that the average performance of pupils in the field of mathematics is rather disappointing and that the typology of the school (thus, the school ecosystem or, more simply, the school context) has an impact on the development of certain skills (Dieng and Ibrahima, 2020), particularly in the construction of numbers (Diagne, Kafano and Ounteni, 2006) and mental arithmetic (Ndoye, 1999 and Arneton, 2010).

3. Pupils' overall attitudes

Among the pupils tested for their mental arithmetic skills, we chose 556 (470 in Senegal and 86 in Martinique) to explore their relationship with mathematics and arithmetic, but also about their domestic habits (in order to detect whether they carried out mathematical-type activities at home). To guarantee the homogeneity of the data, the sample was composed of approximately one hundred pupils per level in Senegal (CP, CE1, CE2, CM1 and CM2) and three classes for each school level in Martinique (15 classes in total). Data collection was carried out using a questionnaire with six non-gendered questions, focusing on pupils' interest in mathematics and mental calculation. The first four questions were closed and the last two were open-ended. The first four questions were closed, while the last two were open-ended, so that the student could let his or her experience run wild and fill in the questionnaire without being restricted.

The answers we obtained seem to suggest that students from both populations have a relatively positive conception of mathematics. Indeed, 97% of the respondents said that they liked mathematics among the mainlanders (a little, well, and a lot) - 93% said that they liked mathematics among the islanders, while an average of 5% disliked it (Tables 9). This can be explained by the teaching methods proposed by the teachers, but also by the diversity of the educational offer.

Do you like maths ?	***Number of pupils***		***Percentage***	
	Martinique	***Sénégal***	***Martinique***	***Sénégal***
I don't like Maths at all	4	1	5%	1%
I don't like maths	2	11	2%	2%
I like maths a bit	14	19	**16%**	4%
I like maths	14	47	**16%**	10%
I like maths very much	**52**	**392**	**61%**	**83%**
Total	**86**	**470**	**100%**	**100%**

Table 9: Pupils and their relationship to mathematics

In Senegal, we note that the pupils' relationship to numbers on the one hand and to mental calculation on the other does not fluctuate. These results are therefore identical. This could be directly linked to the need to use mental arithmetic and numbers. In interviews with some of the students who participated in this study, the previous hypothesis was confirmed. Furthermore, it was found that mental manipulation of numbers is a common task in everyday life (for indeed, shopping).

In Martinique, this relationship is more variable. Although 94% of the pupils interviewed expressed an interest in numbers (as an area of activity) and mental arithmetic (as a school exercise), they were divided into three distinct typologies. Firstly, the enthusiasts (58%), the good students (those who like the exercise itself, 36%), and finally those who do not like mathematics-related activities (6%. Table 10).

Do you like numbers and mental calculation?	***Number of pupils***		***Percentage***	
	Martinique	***Sénégal***	***Martinique***	***Sénégal***
I don't like mental calculation at all	3	1	4%	1%
I don't like mental calculation	2	11	2%	2%
I like mental calculation a bit	7	19	8%	4%
I like mental calculation	24	47	**28%**	10%
I like mental calculation very much	**50**	**392**	**58%**	**83%**
Total	**86**	**470**	**100%**	**100%**

Table 10 : Distribution of pupils according to their relationship to numbers and mental calculation

In Martinique, the results reveal that 30% of the pupils who participated in this survey do not use numbers and mental arithmetic at all in the family context, whereas 69% of the pupils in the same sample say they use numbers and mental arithmetic when they are at home. However, few of them are really able to correctly identify activities that require the performance of quick calculations (e.g. following cooking recipes or counting points in a board game) and to differentiate them from other games or household tasks that do not necessarily require the use of calculation.

In Senegal, pupils are very clear about their intentions and uses of numbers and mental arithmetic. 95% of pupils attest to using mental arithmetic. 85% of them clearly target their use by testifying to a daily and practical use of the tool. The Martinican pupils' relationship with mathematics is largely positive, despite their general performance and a domestic context that does not seem to be in the habit of integrating calculation automatisms into everyday activity. Summarizing the general view, one of the pupils in our study admitted to us that: "mental arithmetic is useful in many board games such as *Triomino*, *Trianglué*, *Uno*, *Jeu de l'oie*, *Jeu de 7 familles*, *Domino* and even *Loto*".

In contrast, among their Senegalese counterparts, the concepts studied in mental arithmetic are directly applied in everyday life, often for commercial purposes, in order to participate in family life, or to accompany their parents in their daily activities (going to the shopkeeper's, helping in the family business). 65% of young Senegalese reflect this pattern, 19% remain on a completely academic pattern and only 16% remain unaffected by the use of the mathematical notions studied.

Finally, the results also seem to suggest that the discipline is valued more in its operational dimension (calculation) than in its conceptual dimension (mathematics as an abstraction).

4. Discussion of the results

This research, based on a sociological approach, made it possible to succinctly expose the level of mathematical skills of many pupils in Martinique and Senegalese elementary schools, using a reliable psychometric tool validated by the scientific community on a large scale and relying on a statistically representative sample. Above all, we confirm the ease of use and validity of this tool, the TRDM, which could easily be deployed in other post-colonial overseas contexts to facilitate the comparison work.

It is important to note that in our study we did not detect significant differences between the performance of girls and boys. This statistical consistency could be explained by considering that the gender gap[12] in STEM (probably already at work in childhood, as suggested by some authors including Makarova *et al.*, 2019 and Miller *et al.*, 2018), only becomes stronger and more visible from adolescence onwards[13]. On the other hand, other sociological variables must be considered to explain certain differences in performance. The results confirm that the type of school (which generally reflects the socio-economic status of the students' families) partly determines the level of performance achieved by the students (in line with the findings of Mc Andrew *et al.*, 2008) and that students from public schools as

[12] That is, the gender inequality that is generated in certain contexts by the effect of certain traditions, norms or socio-cultural values and that produces differences in treatment or performance between men and women.

[13] This explains why this research item is considered by the Program for International Student Assessment (PISA) studies, conducted by the Organization for Economic Co-operation and Development (OECD), which focus on secondary school students. In the most recent rounds of PISA, France was positioned in the group of the most unequal countries (behind Venezuela), where the rate of boys outperforming girls in mathematics is the highest (Stoet and Geary, 2013).

well as students from schools located in reinforced priority education networks have the most difficulties with mathematics. In the future, it would be desirable to examine this aspect in greater depth, trying to detect more precisely the impact of certain variables such as the cultural capital of families (Bourdieu, 1979), the school effect (Cousin, 1993) or the teacher effect (Bressoux, 2001).

The results that we obtained suggest that in both territories, the rate of acquisition of skills in the construction of numbers varies according to several parameters (systemic, socio-economic). Indeed, in contrast to the results of pupils in Senegal, where the progression curve of acquisitions is rather slow and stable, those obtained by pupils in the academy of Martinique show a loss of speed between the first and the third grade. Even though mathematics teaching begins in nursery school with various activities relating to the construction of numbers and their representation in figures, it seems essential to consolidate these acquisitions.

Our two postcolonial populations are confronted with the plurality of languages in their region. As a result, the linguistic barrier can be considered as a hypothesis. Indeed, some authors have hypothesised that the mastery of the language, but also the specificities of the latter (notably in the field of semantics and nomenclature associated with mathematics) may have an impact on the learning of numeration, and then of calculation (Jarlégan, Fayol and Barouillet, 1996). Mélissa Arneton, in her doctoral thesis (2010), explored the Caribbean context based on this hypothesis, although in her study she finally concluded that "whatever the school level considered, the linguistic type has no link with school performance in either French or mathematics. Bilingual students do not perform worse than monolingual students" (Arneton, 2010: 339). However, his work did not consider the very particular linguistic construction of cardinal numbers - the natural integers - which is specific to the Wolof language (Eglash, 1997) and also specific to the Creole language (and which are also linked to the vigesimal system specific to the French language). The linguistic construction of numbers, which requires many exercises to be mastered, could explain the initial difficulties of pupils who construct numbers from their mother tongue (Wolof or Creole)[14], especially during the first years of school.

[14] - One example is the name associated with the number 32. In French, we say *trente-deux*, id est, thirty plus two. The pupil must know that thirty is three tens. In Wolof, we say *nett-fukk ak ñaar*, i.e. three times ten plus two. The modality common to French and Wolof calls for the concept of multiplication. It is explicit in Wolof but not in French. An example is the name associated with the number 92. In French, we say *quatre-vingt-douze*, i.e., four times twenty plus twelve. In Creole, we say *katrèvendis dé*, i.e., four times twenty plus ten plus

Finally, regarding our secondary survey, which served as a corollary to the TRDM, we suggest that the relatively positive relationship to mathematics and more specifically to mental arithmetic in our two territories could be explained in a few points.

In Martinique and Senegal, teaching of mathematics in primary school is often associated (by teachers or in textbooks) with a playful or cultural approach (which is moreover recommended by the respective official curricula) and by representations that are not yet contaminated by the context effect. There is a political will to improve the level of students in mathematics and the evolution of its place in the official curricula testifies to this (for indeed, in Senegal it operates the Project for the reinforcement of the teaching of mathematics, science, and technology, PREMST).

The fact that students value the operational dimension (calculation) over the conceptual one (mathematics as an abstraction) has been confirmed by other studies (Papp and Theresa, 2017; Swacha, 2021). It invites us to imagine innovative didactic strategies that take advantage of the opportunities offered by gamification and the use of serious games, escape games and other similar activities to facilitate the learning of computational automatisms.

Conclusions

This research shows us an updated and statistically representative panorama of social representations towards mathematics and the performance of primary schools' pupils in Martinique and Senegal, in the field of number construction and mental calculation. We hope that other similar studies can be carried out in the future: the large-scale deployment of the MDRT combined with a sociological survey would provide the competent public authorities with a more complete panorama that would facilitate the detection of territorial inequalities and to refine the strategies aimed at improving the results and performance of pupils.

References

two. The modality common to French and Creole calls for the concept of multiplication. In the variants of French spoken in Belgium, Switzerland, and Quebec, on the other hand, we say *nonante-deux*, which appears to be simpler to conceptualize (by appealing only to an addition in the decimal system).

Académie de Martinique. (2021). *L'académie en chiffres 2020-2021*. Schoelcher : Rectorat de Martinique.

Adelman, C. (2009). International comparisons: What your fourth-grade math can reveal. *International Higher Education*, (55), 21-23.

Alì, M. (2020). The Education System in the French Departments of America: French Guiana, Martinique and Guadeloupe. Dans J. Sieglinde et M. Parreira do Amaral, (dir.) *The Education Systems of the Americas* (pp. 583-606). Bale, Suisse : Springer Nature, https://doi.org/10.1007/978-3-319-93443-3_9-1.

Arneton, M. (2010). Bilinguisme et apprentissage des mathématiques : études à la Martinique. Thèse de doctorat à l'Université Nancy 2.

Ascher, M. et Ascher, R. (1986). Ethnomathematics. *History of science, 24*(2), 125-144.

Ashcroft, B., Griffiths, G. & Tiffin, H. (1995). (Eds.) The postcolonial studies reader. London : Routledge

Aunio, P. et Niemivirta, M. (2010). Predicting children's mathematical performance in grade one by early numeracy. *Learning and Individual Differences*, *20*(5), 427-435. https://doi.org/10.1016/j.lindif.2010.06.003

Bangura, A. K. 2020. The African Mother Tongue and Mathematical Ideas : A Diopian Pluridisciplinary Approach. Wilmington : Vernon Press.

Botes, H. & Mji, A. (2010). Language diversity in the mathematics classroom: does a learner companion make a difference? *South African Journal of Education*, 30(1), 123-138. http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S0256-01002010000100009&lng=en&tlng=en.

Bishop, A. J. (1990). Western mathematics: The secret weapon of cultural imperialism. *Race & Class, 32*(2), 51-65.

Bosch, M., Chevallard, Y. et Gascón, J. (2006). Science or magic? The use of models and theories in didactics of mathematics. Dans *Proceedings of the fourth congress of the European Society for research in mathematics education* (pp. 1254-1263). Barcelona: Fundemi IQS–Universitat.

Bourdieu, P. (1979). Les trois états du capital culturel. *Actes de la recherche en sciences sociales, 30*(n.s. L'institution scolaire), 3-6. https://doi.org/10.3406/arss.1979.2654.

Bressoux, P. (2001). Réflexions sur l'effet-maître et l'étude des pratiques enseignantes*. Les dossiers des sciences de l'éducation, 5*(1), 35-52. https://doi.org/10.3406/dsedu.2001.949.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental psychology, 22*(6), 723.

Bronfenbrenner, U. (2005). *Making human beings human: Bioecological perspectives on human development*. Londres: SAGE.

Butterworth, B. (2005). The development of arithmetical abilities. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *46*(1), 3-18. https://doi.org/10.1111/j.1469-7610.2004.00374.x

Chemillier, M. 2008. Éléments pour une ethnomathématique de l'awélé », *Mathématiques et sciences humaines*, n°181. [En ligne] http://journals.openedition.org/msh/8883.

Chronaki, A., Adams, G., Andrade, M., Bruno, G., Demissie, F., Marcone, R., Para, A., Povey, H., Swanson, D., Valero, P. et Yolcu, A. (2019). *Unfolding global/local policies, practices and/or hybrids in mathematics education worldwide: utopias, pleasures, pressures and conflicts*. Dans Proceedings of the Tenth International Mathematics Education and Society Conference. MES10, Janvier 10. http://shura.shu.ac.uk/24289/.

Cousin, O. (1993). L'effet établissement : construction d'une problématique. *Revue française de sociologie, 34*(3), 395-419. https://doi.org/10.2307/3321974.

D'Ambrosio, U. (1980). Matemática e Sociedade: Considerações Histórico-Pedagógicas. *Ciência e filosofia,* (2), 81-88.

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K. et Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, *43*(6), 1428-1446. https://doi.org/10.1037/0012-1649.43.6.1428

Feza, N. N. (2018). Black Students' Rich Mathematical Experiences: Mathematics Concepts and Xhosa Cultural Games for Reception Class. *Early Childhood Education*. https://doi.org/10.5772/intechopen.81039

Garcon, M. (2021). *Les maths ? Même pas peur ! Bilan de la première période d'exercice du Plan Math de l'Académie de Martinique*. Communication présentée aux Journées de la Recherche en Éducation (JRE2021) de l'Université de la Polynésie française. Faa'a, Tahiti, Polynésie française, 28-29 avril.

Garçon, M. (2022). Corpus de recherche. Résultats du projet Calcul Mental Africa2020 (volet 1 : test de calcul mental en Martinique). *Mendeley Data, V1*. https://doi.org/10.17632/j9yfh482r4.1.

Georges, C., Cornu, V. et Schiltz, C. (2021). The importance of visuospatial abilities for verbal number skills in preschool: Adding spatial language to the equation. *Journal of Experimental Child Psychology, 201*: 104971. https://doi.org/10.1016/j.jecp.2020.104971.

Ghazali, M., Mohamed, R. et Mustafa, Z. (2021). A Systematic Review on the Definition of Children's Number Sense in the Primary School Years. *EURASIA Journal of Mathematics, Science and Technology Education, 17*(6): em1968. https://doi.org/10.29333/ejmste/10871.

Halai, A., Muzaffar, I. et Valero, P. (2016). Research rationalities and the construction of the deficient multilingual mathematics learner. Dans R. Barwell, P. Clarckson, A. Halai, M. Kazima, J. Moshkovich, N. Planas, M. Setati-Phakeng, P. Valero et M. Villavicencio Ubillus. (dir.), *Mathematics education and language diversity* (p. 279-295). Springer - International Commission on Mathematical Instruction.

Harding, S. (1998). Is science multicultural? Post-colonialisms, Feminisms and Epistemologies, Bloomington: Indiana University Press

Iseke-Barnes, J. M. (2000). Ethnomathematics and Language in Decolonizing Mathematics. *Race, Gender & Class*, *7*(3), 133–149. http://www.jstor.org/stable/41674951

Jarlegan, A., Fayol, M., & Barrouillet, P. (1996). De soixante douze à 72, et inversement: Une étude du transcodage chez les enfants de 7 ans. *Revue de Psychologie de l'Education*, *1*, 109-131.

Makarova, E., Aeschlimann, B., & Herzog, W. (2019, July). The gender gap in STEM fields: The impact of the gender stereotype of math and science on secondary students' career aspirations. In *Frontiers in Education* (Vol. 4, p. 60). Frontiers Media SA.

Martini, S. F., Schiltz, C., Fischbach, A. et Ugen, S. (2021). Identifying math and reading difficulties of multilingual children: Effects of different cut-offs and reference groups. Dans A. Fritz, E. Gürsoy, M. Herzog (dir.) *Diversity Dimensions in Mathematics and Language Learning. Perspectives on culture, education, and multilingualism* (pp. 200-228). Berlin, Boston: De Gruyter.

Martin, D. B. (2000). Mathematics success and failure among African-American youth: The roles of sociohistorical context, community forces, school influence, and individual agency. Routledge.

Mc Andrew, M., Garnett, B., Ledent, J., Ungerleider, C., Adumati-Trache, M. et Ait-Said, R. (2008). La réussite scolaire des élèves issus de l'immigration: une question de classe sociale, de langue ou de culture ?. Éducation et francophonie, 36(1), 177-196.

Mejias, S., Muller, C. et Schiltz, C. (2019). Assessing Mathematical School Readiness. *Frontiers in Psychology*, *10*, 1173. https://doi.org/10.3389/fpsyg.2019.01173

MENJS - Ministère de l'Éducation Nationale, de la Jeunesse et des Sports (2018). *Bulletin officiel spécial n°3 du 5 avril 2018. Enseignement du calcul : un enjeu majeur pour la maîtrise des principaux éléments de mathématiques à l'école primaire.* Repéré à : https://www.Éducation.gouv.fr/bo/18/Special3/MENE1809042N.htm

Miller, D. I., Nolla, K. M., Eagly, A. H., & Uttal, D. H. (2018). The development of children's gender-science stereotypes: A meta-analysis of 5 decades of US Draw-a-Scientist studies. *Child development*, *89*(6), 1943-1955.

Papp, T. A. et Theresa, A. (2017). Gamification effects on motivation and learning: Application to primary and college students. *International Journal for Cross-Disciplinary Subjects in Education, 8*(3), 3193-3201.

Rosa, M. & Orey, D. C. (2011). Ethnomathematics: the cultural aspects of mathematics. Revista Latinoamericana de Etnomatemática, 4(2). 32-54

Said, E. (1978). Orientalism. London: Routledge and Kegan Paul

Selin, H. (dir.) (2000). *Mathematics Across Cultures. Science Across Cultures: The History of Non-Western Science*. Dordrecht: Springer.

Stoet, G. et Geary, D. C. (2013). Sex differences in mathematics and reading achievement are inversely related: Within- and across-nation assessment of 10 years of PISA data. *PLoS One, 8*(3), e57988. https://doi.org/10.1371/journal.pone.0057988.

Super, C. M. et Harkness, S. (1986). The developmental niche: A conceptualization at the interface of child and culture. *International journal of behavioral development, 9*(4), 545-569.

Swacha, J. (2021). State of research on gamification in education: A bibliometric survey. *Education Sciences, 11*(2), 69.

Tiendrebeogo, E. S. et Tamura, K. (2022). Quality of Mathematics Education in Burkina Faso Junior High School: Prescriptions, Practices, and Issues. *NUE Journal of International Educational Cooperation, 15*, 41-49.

Traoré, K. et Bednarz, N. (2009). Mathématiques de la vie quotidienne au Burkina Faso: une analyse de la pratique sociale de comptage et de vente de mangues. *Educational Studies in Mathematics, 72*(3), 359-378.

Von Aster, M. (2000). Developmental cognitive neuropsychology of number processing and calculation: Varieties of developmental dyscalculia. *European Child & Adolescent Psychiatry*, 9(II) : 41-57. https://doi.org/10.1007/s007870070008

Weitekamp, M. A. (2017). The image of scientists in The Big Bang Theory. *Physics Today. 70*(1): 40–48. https://doi.org/10.1063/PT.3.3427.