International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/

Vol. 58 No. 1 July 2026, pp. 984-992

Why Relative Age Effect Matters: An Exploratory Study Of Grade 4 Pupils In Madagascar

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Abstract: The Relative Age Effect refers to the potential influence of age differences among pupils belonging to the same school cohort. Although extensively investigated in many educational systems, it remains relatively underexplored in Madagascar. This exploratory study examines the possible relationship between age and academic performance among Grade 4 pupils and seeks to raise awareness of the educational relevance of relative age in Malagasy primary schools. The analysis was based on data collected from 70 Grade 4 pupils enrolled in 4 schools in Atananarivo Avaradrano. Pupils' date of birth, age and academic performance were analyzed using Spearman and Kendall rank correlation coefficient, graphical representation and simple linear regression model. The results suggest a tendency for relatively younger pupils to be associated with more favorable academic performance categories than relatively older pupils.

Keywords: relative age effect, academic performance, school age, primary education, Madagascar, RAE

1. INTRODUCTION

Age is one of the primary criteria used to organize children's schooling. In most educational systems, pupils are grouped according to their year of birth and follow the same curriculum despite age differences that may reach several months or even more than one year [1]. As a result, pupils enrolled in the same grade level may differ considerably in age, a situation that has attracted growing attention in educational research [2].

In Malagasy primary schools, age diversity may also be observed within the same classroom. This situation raises the following research question: To what extent are age differences among pupils enrolled in the same grade level associated with academic performance? The objective of this study is to examine the potential relationship between age and academic performance among pupils belonging to the same primary schools cohort.

The hypothesis of this study is that relatively older pupils are more likely to achieve higher academic performance than relatively younger pupils within the same cohort.

To investigate this issue, data collected from 70 Grade 4 pupils enrolled in 4 schools in Antananarivo Avaradrano were analyzed using descriptive statistics, Spearman's rho and Kendall's tau rank correlations, graphical representation, and a simple linear regression model.

The article begins with a review of the main concepts related to age and school performance. It then presents the methodology, followed by the empirical findings. The final sections discuss the results and their implications for Malagasy primary school stakeholders.

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2. BASIC CONCEPTS

This section provides a conceptual framework linking child development and school performance, defining age not merely as a chronological variable but as a proxy for biological maturation and intellectual growth.

2.1 Age and Child Development

Unlike adulthood, where age gaps of several months or even years generally have little impact on individual capacities, childhood is characterized by ever-changing biological, cognitive, linguistic, and socio-emotional change. During the primary school years, children progressively acquire new capacities in reasoning, language, attention, memory, and self-regulation, which support their participation in learning activities [3].

Developmental theories emphasize that these capacities do not emerge simultaneously but evolve gradually through successive stages of growth. Consequently, children of different ages may display different levels of development even when they are enrolled in the same grade level.

Gesell [4] highlighted the importance of biological maturation in children's psychological development. From this perspective, age constitutes an indicator of developmental progression during childhood and provides a useful framework for understanding individual differences among pupils.

2.2 Developmental Readiness

The Relative Age Effect (RAE) refers to the potential influence of a pupil's age position within the same school cohort on educational outcomes [5]. Because school admission is generally organized according to a fixed cut-off date, pupils enrolled in the same grade may differ in age while being exposed to identical curricula, teaching practices, and assessment procedures.

The classical interpretation of RAE assumes that pupils born earlier within the cohort are more likely to benefit from developmental advantages during the first years of schooling. These advantages are frequently associated with stronger academic performance and better adaptation to school requirements.

Several studies support this interpretation. Bedard and Dhuey [6] reported that pupils born earlier within the school-entry cycle generally achieve higher academic outcomes than those born later. Similar conclusions were reached by Crawford et al. [7], who identified relative age as an important predictor of educational achievement.

In the francophone context, Rakotomalala [8] also reported academic advantages among pupils born earlier within the same cohort. Likewise, Urruticoechea et al. [9] found that relatively older pupils tend to achieve better educational outcomes and experience fewer learning difficulties.

2.3 Alternative Perspectives

Although the Relative Age Effect is frequently interpreted through differences in developmental maturity, research suggests that its manifestations may vary across educational contexts. In some settings, relatively older pupils do not systematically achieve better academic outcomes than their younger classmates.

Evidence from several African countries points to a more complex relationship between age and school performance. PASEC [10], for example, reported a negative association between pupils' age and achievement in reading and mathematics. In these contexts, older pupils enrolled in the same grade were not always the highest achievers.

These findings suggest that age within a grade level may reflect more than developmental maturity alone. Pupils of the same grade do not necessarily share identical educational experiences, learning opportunities or schooling histories. Consequently, the relationship between age and academic performance may vary according to the educational environment in which pupils evolve.

This perspective may be particularly relevant in Madagascar. Studies have shown that age diversity within primary school classrooms can be substantial. National statistics indicate that repetition rates approached 35% between 2000 and 2002 before

declining to around 20% from 2003 onward [11]. Such figures suggest that pupils attending the same grade level may sometimes follow different educational pathways.

In addition, some authors have noted that age differences within classrooms may influence how pupils are perceived by teachers and peers. Such perceptions may contribute to the emergence of age-related expectations and stereotypes that accompany pupils throughout their schooling experiences [12], [13].

3. METHODOLOGY

This study adopts a quantitative exploratory design to investigate the association between age and academic performance among Grade 4 pupils. Data were collected from 83 Grade 4 pupils enrolled in 4 schools located in Antananarivo Avaradrano: CP Faly, EP CEMEAM, Collège Dimbin'ny Ala and CPC Rafiringa. The information gathered included pupils' complete date of birth (day, month and year) and their academic performance during September 2024 until April 2025. Following data verification, consistency checks and the exclusion of incomplete records, 70 observations were retained for analysis.

Data analysis was conducted using the R language and RStudio software. Non-parametric rank correlations were then computed using Spearman's rho and Kendall's tau coefficients through the R functions cor.test(method = "spearman") and cor.test(method = "kendall") [14]. These analyses were used to assess the direction and consistency of the association between variables. Academic performance was subsequently represented graphically through a scatter plot in which academic performance categories were treated as an ordinal variable and age as a continuous variable. A simple linear regression line ($y = ax + b$) [15] was added to visualize the overall tendency observed within the sample.

4. NEGATIVE ASSOCIATION BETWEEN AGE AND ACADEMIC PERFORMANCE

This section presents the empirical findings regarding the relationship between pupils' chronological age and their academic achievement. By combining non-parametric correlation tests with a detailed graphical analysis, these results offer an overview of how age variations manifest in classroom outcomes.

4.1 Correlation analysis

Prior to the correlation analyses performed at both the school level and the overall sample level, a contingency table was established to summarize the distribution of the 70 pupils according to age and academic performance categories.

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Table-1: Distribution of Academic Performance Categories According to Age

		Academic performance						
		Low (1)	**Insufficient (2)**	**Satisfactory (3)**	**Fairly good (4)**	**Good (5)**	**Very good (6)**	**Total**
Age	**7.6**	0	1	0	1	0	0	**2**
	8	0	0	0	1	0	0	**1**
	8.3	0	1	0	0	0	0	**1**
	8.5	0	0	1	1	0	0	**2**
	8.6	0	1	0	0	0	0	**1**
	8.7	0	0	0	1	0	0	**1**
	8.8	1	1	1	0	1	0	**4**
	8.9	0	1	2	2	1	0	**6**
	9	1	1	0	0	0	0	**2**
	9.1	0	1	1	0	0	0	**2**
	9.3	0	2	0	0	1	0	**3**
	9.4	0	3	3	0	0	0	**6**
	9.5	1	2	2	1	0	1	**7**
	9.6	0	0	2	0	0	0	**2**
	9.7	0	0	1	1	0	0	**2**
	9.8	1	0	2	0	0	0	**3**
	9.9	0	0	2	0	1	0	**3**
	10	0	2	0	0	1	0	**3**
	10.2	0	0	0	1	1	0	**2**
	10.3	0	0	2	0	0	0	**2**
	10.5	0	1	0	0	0	0	**1**
	10.6	2	0	1	0	0	0	**3**
	10.7	0	1	0	1	0	0	**2**

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10.8	1	0	1	0	0	0	**2**
10.9	0	0	1	0	0	0	**1**
11.2	0	2	0	0	0	0	**2**
11.3	0	0	1	0	0	0	**1**
11.6	1	0	0	0	0	0	**1**
11.7	0	1	0	0	0	0	**1**
12.3	0	1	0	0	0	0	**1**
Total	**8**	**22**	**23**	**10**	**6**	**1**	**70**

Table-2: Spearman correlation Coefficient (rho) Between Age and Academic Performance

SCHOOL	NUMBER OF STUDENTS	RHO	P-VALUE
EP CEMEAM	12 out of 70	-0.374	0.230
CPC RAFIRINGA	11 out of 70	-0.403	0.218
DIMBIN'NY ALA	25 out of 70	-0.219	0.293
CP FALY	22 out of 70	-0.006	0.978
ALL	70 out of 70	-0.171	0.158

Table-3: Kendall Correlation Coefficient (tau) Between Age and Academic Performance

SCHOOL	NUMBER OF STUDENTS	TAU	P-VALUE
EP CEMEAM	12 out of 70	-0.273	0.261
CPC RAFIRINGA	11 out of 70	-0.358	0.161
DIMBIN'NY ALA	25 out of 70	-0.171	0.271
CP FALY	22 out of 70	-0.001	1.000
ALL	70 out of 70	-0.125	0.169

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Even if none of the correlations reached the conventional 5% significance level, these preliminary findings suggest a negative association between age and academic performance. Specifically, within the same school cohort, relatively older pupils tend to exhibit lower academic performance, whereas their relatively younger peers achieve higher outcomes.

4.2 Graphical analysis

Before examining the graphical relationship between age and academic performance, the age composition of the sample is first described by gathering the individual characteristics of the 70 pupils included in the study, including their school, date of birth, exact age (on May 2025) and academic performance. To better understand the age composition of the sample, pupils were subsequently grouped according to their year of birth. The resulting distribution is presented in Table 4.

Table-4: Distribution of Pupils According to Year of Birth

Year of birth	**Number of Pupils**	**Percentage (%)**
2017	3	4.28 %
2016	**23**	**32.85 %**
2015	**29**	**41.42 %**
2014	12	17.14 %
2013	3	4.28 %
Total	**70**	**100 %**

Table 4 shows that most pupils were born in 2015 (41.42%) and 2016 (32.85%), together representing 74.27% of the sample. These two cohorts broadly correspond to the age range generally expected in Grade 4. However, pupils born in 2013, 2014, and 2017 are also represented, indicating that noticeable age differences coexist within the same grade level. Such diversity provides a relevant context for examining the possible educational implications of relative age within the classroom.

The graphical exploration was conducted using RStudio commands plot() and abline(). A simple linear regression model was fitted with academic performance as the dependent ordinal variable and age as the explanatory variable.

The estimated regression equation was:

$y = -0.068x + 3.46$

where y represents ordinal academic performance and x represents pupils' age in decimal years.

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Chart-1: Age and Academic Performance Among Grade 4 Pupils

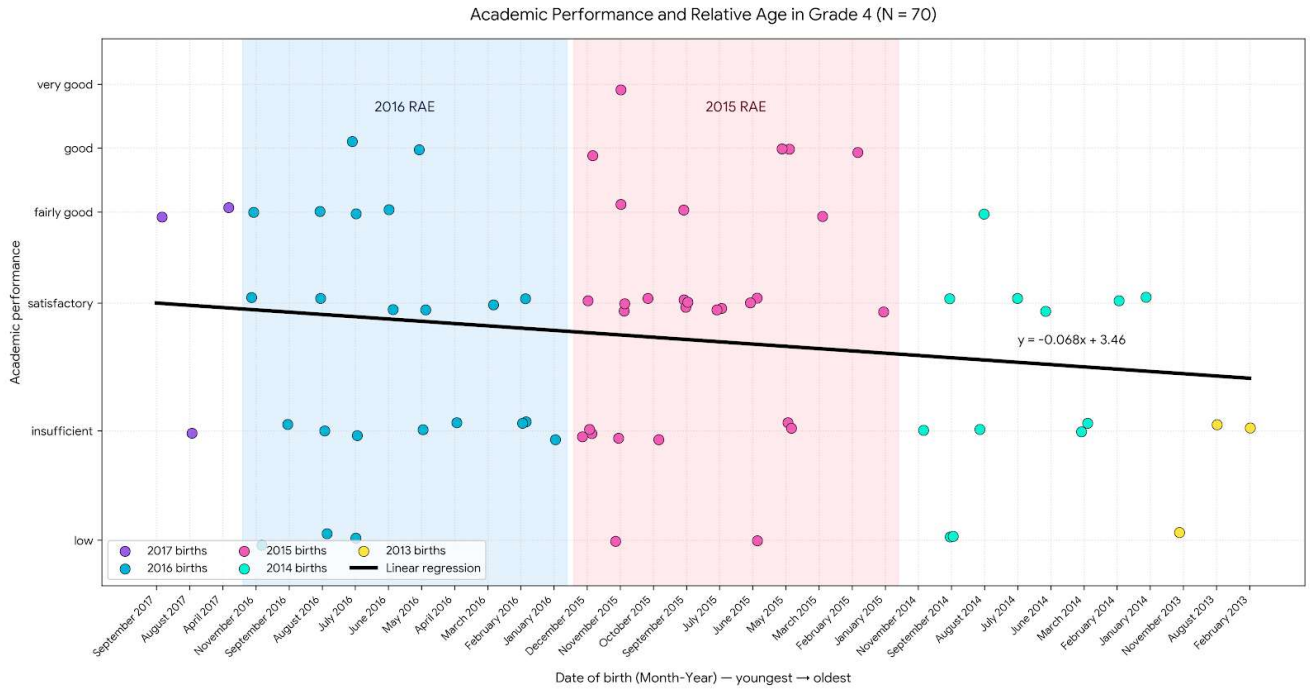

Chart-1 shows that the most favorable academic performance categories are observed more frequently among relatively younger pupils, whereas lower performance categories appear more often among relatively older pupils. The regression line (y = -0.068x + 3.46) also exhibits a negative slope, indicating a slight decline in academic performance as age increases within the sample.

5. DISCUSSION

The initial hypothesis of this study proposed that relatively older pupils would achieve higher academic performance than their younger classmates within the same cohort. The results do not support this expectation. On the contrary, both the graphical analysis and the correlation coefficients suggest an opposite tendency, with younger pupils appearing more frequently in the higher academic performance categories.

Although none of the correlations reached the conventional 5% significance level, all coefficients were predominantly negative. Spearman's rho reached values as low as -0.403, while Kendall's tau reached -0.358. This convergence across different statistical indicators suggests a tendency whereby older pupils may be associated with lower academic performance. While these findings cannot be considered conclusive evidence, they raise questions about the applicability of the classical Relative Age Effect (RAE) interpretation in the context examined here.

The observed tendency appears to be more consistent with findings reported in several African educational systems, particularly those of PASEC [10], where age was found to be negatively associated with academic achievement in certain situations. This contrasts with much of the international literature on RAE [6], [7], [8], [9], which generally reports an academic advantage for pupils born earlier within the same cohort. According to the classical interpretation, these pupils benefit from greater cognitive,

motor, and socio-emotional maturity, facilitating adaptation to school requirements and contributing to higher academic achievement [3].

Rather than viewing these perspectives as contradictory, the present findings suggest that the relationship between age and school performance may depend on contextual factors. Age within a grade level may reflect not only chronological maturity but also a broader set of educational experiences accumulated throughout pupils' schooling.

This interpretation is supported by the composition of the sample itself. Although most Grade 4 pupils belonged to the 2015 and 2016 birth cohorts, the sample also included pupils born in 2013, 2014, and 2017. Such diversity indicates that pupils sharing the same classroom may may not have followed identical educational pathways before reaching the same grade level. Previous studies have shown that grade repetition has historically represented an important feature of school trajectories in Madagascar, with repetition rates around since 2003 [11].

From this perspective, the principal contribution of this article is not to determine whether younger or older pupils perform better in Madagascar. Rather, it seeks to draw attention to the educational relevance of age differences that may exist within the same classroom. Greater awareness of pupils' relative age may help teachers develop a more nuanced understanding of academic performance, learning difficulties, and classroom diversity.

At the same time, age should not be used as a basis for stereotyping pupils. The findings do not imply that younger pupils are systematically more successful or vice versa. Such assumptions may influence teachers' expectations, classroom interactions, and pupils' confidence in their own capacities [13]. Educational decisions should therefore continue to be based on a comprehensive understanding of each learner's individual characteristics, learning history, and educational needs.

6. CONCLUSION

This study examined the possible relationship between age and academic performance among 70 Grade 4 students. Correlation and graphical analysis suggested a tendency for relatively younger pupils to be associated with more favorable academic performance categories than relatively older pupils.

Although this tendency differs from the interpretation most frequently reported in the international literature on the Relative Age Effect (RAE), the present study does not seek to confirm or refute any particular theoretical perspective. Rather, its principal contribution is to draw attention to the potential educational relevance of age differences within the same classroom. The findings suggest that pupils' relative age may constitute one of several factors that teachers can take into account when interpreting academic performance and learning difficulties.

However, the sample remains too limited to support any generalization regarding the Relative Age Effect in Madagascar. Crucially, all correlation analyses conducted in this study yielded coefficients that fell below the 5% statistical significance threshold (p-value > 0.05), Studies on RAE generally require large-scale datasets covering multiple schools, regions, and educational contexts in order to identify robust and representative patterns. Consequently, the tendency observed in this exploratory investigation should be interpreted as an invitation for further reflection rather than as evidence of a national educational reality. Future investigations involving larger samples would provide a stronger empirical basis for understanding the role of relative age in Malagasy primary education and for assessing its implications for educational practice and policy.

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