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## A Multidimensional Didactic Analysis of Trigonometric Errors Among Moroccan Secondary Students

### Communication Info

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- (1) Trigonometry
- (2) Error analysis
- (3) Semiotic registers
- (4) Conceptual and procedural understanding
- (5) Principal Component Analysis

### Abstract

This study analyzes the structuring of trigonometric errors among 120 Moroccan scientific-track students aged 16-17 using a 12-item diagnostic test. The research is grounded in major theories of mathematics education, including the Theory of Didactical Situations [1], the framework interplay approach [2], the Theory of Semiotic Registers [3], and the distinction between instrumental and relational understanding [4]. Results indicate a predominance of procedural errors (68.3%), followed by conceptual (60.8%) and semiotic errors (54.2%), whereas logical errors are less frequent (39.1%). Principal Component Analysis reveals a three-factor latent structure organized around semiotic-conceptual, procedural, and logico-regulative dimensions. Correlation analysis shows strong intra-dimensional consistency ( $r = .65-.79$ ) and moderate to weak inter-dimensional relationships, suggesting a differentiated yet articulated organization of difficulties. These findings align with international research highlighting the interaction between conceptual and procedural knowledge [5]. The results underline a persistent imbalance between symbolic manipulation and conceptual stabilization. The study advocates for instructional approaches that enhance representational coordination, conceptual justification, and reasoning regulation within the Moroccan curriculum context.

### Références

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