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| RESEARCH ARTICLE

## The Proprioceptive Paradigm: Mapping English Prepositions and Spatial Syntax through Motor-Sensory Feedback Loops in Moroccan EFL Beginners who are Completely Visually Challenged

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| ABSTRACT

This study investigates the "Proprioceptive Paradigm" as a multimodal pedagogical framework for teaching English spatial prepositions and syntax to completely visually challenged students during their first year of English instruction in the Moroccan secondary school cycle. Focusing on a beginner cohort aged 14 to 15, the research explores how the student's own body can serve as a primary "grammatical image" through the activation of motor-sensory feedback loops. Employing a qualitative case study design, the research utilizes longitudinal classroom observations of seven completely visually challenged students and a semi-structured interview with their English as a Foreign Language (EFL) teacher. Data were analyzed using the six-phase reflexive thematic analysis method. Findings reveal that physicalizing spatial relations—such as "between," "across," and "through"—effectively anchors abstract grammatical concepts into long-term memory via motoric encoding, bypassing the didactic barriers presented by image-heavy curricula. The study concludes that for completely visually challenged students, the transition from an ocularcentric curriculum to an embodied, kinesthetic approach significantly enhances spatial syntactic acquisition and optimizes learning outcomes for novice learners.

| KEYWORDS

Proprioceptive Paradigm; Motor-Sensory Feedback Loops; English Spatial Prepositions; Completely Visually Challenged Students; Moroccan EFL Beginners

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### 1. Introduction:

#### 1.1. Background of the Study

The introduction of English in the third year of secondary school in Morocco represents a foundational milestone in the linguistic development of Moroccan youth. For many students, this 9th-grade experience is their first formal contact with English as a Foreign Language (EFL). Historically, Second Language Acquisition (SLA) has been dominated by "spectatorial pedagogy," a framework that privileges the visual modality as the primary conduit for knowledge transfer (Styhre, 2010). In contemporary Moroccan education, beginner-level curricula are designed with a heavy reliance on visual prompts to facilitate the understanding of vocabulary and grammar. This ocularcentric approach assumes a visual subject, utilizing pictures, diagrams, and charts to establish the context for linguistic meaning (Kavanagh, 2013). For completely visually challenged students, the traditional pedagogical focus on the "eye" creates a significant didactic mismatch. While Morocco's "Strategic Vision 2015-2030" and the 2019 "no child left behind" program emphasize the right of completely visually challenged students to access quality education, the materials used during the first year of English study are frequently designed around visual stimuli (Naciri, 2022). This research proposes a shift toward the "Proprioceptive Paradigm." By leveraging the body's internal sense of self-position (proprioception), this model replaces the missing visual image with a motoric "felt image," allowing the sensorimotor system to ground language in physical reality (Pulvermüller, 2018).

## 1.2. Problem Statement

The curriculum for beginner EFL students in Morocco is systematically ocularcentric. Standard instructional materials for the third year of secondary school rely on visual representation to explain spatial relationships. For completely visually challenged students, this design creates a "contextual void" that hinders the acquisition of lower-order linguistic skills, specifically spatial prepositions and basic syntax (Tahiri, 2023). Without a visual scaffold, these beginner learners are often forced to engage in abstract guessing, which increases cognitive load and results in a delay in mastering spatial terms compared to their sighted peers (Monaikul & Di Eugenio, 2020). There is a notable lack of empirical research in the Moroccan context regarding how 14-15-year-old beginners who are completely visually challenged can utilize their motor systems to simulate the "image" of a word, leading to significant didactic barriers in mainstream classrooms.

## 1.3. Research Objectives

- To evaluate how proprioceptive feedback loops, enacted through specific body-based movements, facilitate the comprehension and retention of English spatial prepositions among completely visually challenged students at the beginner level.
- To design a pedagogical model where the "body-as-image" serves as a functional scaffold for mastering spatial syntax within the introductory Moroccan secondary curriculum.
- To analyze the specialized EFL teacher's perceptions regarding the effectiveness and practical implementation of kinesthetic strategies for students with a complete visual challenge.
- 1.4. Research Questions
- How do proprioceptive feedback loops (body-based movements) facilitate the comprehension of spatial prepositions among completely visually challenged students during their first year of English study?
- In what ways can a "body-as-image" pedagogical model serve as a scaffold for mastering spatial syntax in a Moroccan secondary school setting?
- What are the EFL teacher's perceptions regarding the effectiveness of kinesthetic strategies when teaching beginner students with a complete visual challenge?

## 1.5. Significance of the Study

- This study provides an objective framework for addressing the sensory barriers inherent in the Moroccan ELT system. By demonstrating that the body itself can act as a grammatical map, the research offers a low-cost, effective solution for secondary schools, empowering teachers to deliver inclusive lessons without waiting for specialized tactile versions of print materials. Furthermore, the study aligns with the "Digital Morocco 2030" strategy for "Inclusive Usage," positioning the kinesthetic modality as a legitimate academic tool for students with a complete visual challenge (MMSP, 2024). This work contributes to the "Embodied Turn" in applied linguistics, validating the unique auditory-spatial intelligence of completely visually challenged students.

## 1.6. Key Concepts

- **Proprioceptive Paradigm:** A multimodal learning model where the internal awareness of body position is utilized to encode and ground linguistic meaning (Barsalou, 2008).
- **Motor-Sensory Feedback Loops:** A continuous neurological process where a physical action produces sensory data that confirms the conceptual "image" of a word (Hickok & Houde, 2010).
- **Spatial Syntax:** The grammatical arrangement of prepositions and nouns to indicate the position or movement of entities in 3D space.
- **Completely Visually Challenged Students:** Learners with total lack of functional vision who rely on non-visual channels for information processing.
- **Students with a Complete Visual Challenge:** An objective category describing learners who face environmental or sensory barriers within a standardized curriculum (Konnerup, 2018).
- **Beginner Level (EFL):** Learners in their first year of English study, aged 14-15, focusing on foundational communicative competencies.

## 2. Theoretical Framework:

The Proprioceptive Paradigm is supported by theoretical pillars that explain how language is processed in the absence of vision.

**2.1. Embodied Cognition** Embodied Cognition theory (Barsalou, 2008; Pulvermüller, 2018) posits that language meaning is grounded in the brain's motor and perceptual systems. For a beginner learner, a word like "under" is not merely an abstract concept; it is a mental simulation of a physical relationship. For completely visually challenged students, this simulation is most

effective when paired with a motoric act. Meaning is not found in an external image, but in an "immersive experience" within the body (Zwaan, 2004).

**2.2. Sensorimotor Integration** This framework explains how the brain synthesizes auditory input with motor output (Hickok & Poeppel, 2007). In the presence of a visual challenge, the "dorsal stream" of the brain recruits proprioceptive and tactile cues to map "where" things are in space. This integration allows the student to "see through movement," providing the metric stability that sighted students obtain from textbook illustrations (Voss, Lassonde, & Lepore, 2004).

### **3. Conceptual Framework: The Body as Grammatical Image**

The conceptual framework for this study is the Proprioceptive Scaffold. In this model, the student's own body becomes the reference point for English grammar. Prepositions are not taught as abstract definitions but as physical coordinates. For instance, the preposition "above" is introduced through an upward arm extension, while "in" is introduced through the sensation of a hand enclosed in a container. This transforms the Moroccan classroom from a site of visual observation into a site of physical enactment, where the "image" of the preposition is felt through motoric feedback.

## **4. Literature Review:**

### **4.1. The Ocularcentric Curriculum in Morocco**

A critical analysis of the Moroccan EFL landscape begins with Ed-Dali (2024), who aimed to evaluate the role of visual and auditory features in Moroccan textbooks using a multimodal integration framework. The study found that a high percentage of grammar tasks in these textbooks rely exclusively on "Look at the picture" prompts to establish context. However, the researcher missed a deeper investigation into how these ocularcentric tasks create a specific exclusion factor for completely visually challenged students. This study helps the current research by establishing the baseline ocularcentric barrier that necessitates an alternative pedagogical paradigm.

Furthermore, Tahiri (2023) conducted semi-structured interviews with 15 completely visually challenged students across Moroccan universities to identify academic and environmental barriers. The results revealed a significant "contextual void" where students often engage in "abstract guessing" because educational materials lack non-visual grounding. While Tahiri (2023) provided a robust overview of barriers, the study missed a focus on specific kinesthetic interventions for beginner-level syntactic mastery. This helps the present study by validating the psychological impact of ocularcentricism—specifically the "spatial anxiety" that results from a curriculum designed for sighted learners.

### **4.2. Spatial Language and Visual Challenge**

In the domain of spatial language acquisition, Pérez-Pereira and Conti-Ramsden (2013) aimed to examine the development of spatial terms and social interaction in children with a visual challenge. They found that completely visually challenged students often exhibit delays in "allocentric" spatial terms—those describing relationships between independent objects—due to a lack of incidental visual observation. However, they missed the opportunity to test kinesthetic feedback loops as a remedial strategy to bridge this developmental gap. This study connects to the current research by identifying the specific linguistic challenge (allocentric coding) that the Proprioceptive Paradigm aims to address.

Empirical support for kinesthetic solutions is found in Guerriero, Moscatelli, and Mancini (2025), who aimed to assess whether school-based proprioceptive and plyometric training could improve the spatial awareness of students with a visual challenge. Their findings showed significant clinical improvements in spatial orientation and metric perception following proprioceptive exercises. The study missed the chance to link these physical gains to formal language acquisition or syntactic mapping. This helps the current research by providing neuro-motor evidence that proprioceptive training is a viable surrogate for the visual "image" in educational settings.

Historical insights from Bigelow and Bryan (1982) aimed to document the acquisition of prepositions "in," "on," and "under" in students with a complete visual challenge. They found that "in" and "on" were acquired relatively early (around 33 months), but "under" was significantly delayed until 38 months because it requires understanding that one object can be hidden by another. They missed analyzing how this delay persists into foreign language learning for adolescent beginners. This helps the current research by highlighting which spatial concepts require the most robust "body-as-image" scaffolding to ensure conceptual clarity.

Landau (1991) investigated whether visual experience is necessary for the representation of object-part spatial terms like "top" and "bottom." The study found that a three-year-old student with a complete visual challenge produced error rates very close to sighted children, suggesting the motor system can successfully simulate these spatial properties. Landau (1991) missed the

exploration of how these early representative abilities can be scaled to master complex clausal boundaries in 14-year-old EFL learners. This supports the present study's premise that the motor cortex provides the spatial "metric" that vision normally provides.

Finally, Mulford (1988) aimed to examine the production of deictic devices like "this/that" and "here/there" in completely visually challenged children. The findings revealed significant delays in these spatial devices until age six, largely because they were rarely accompanied by clarifying gestures. Mulford (1988) missed the impact of intentional, teacher-led physicalized gestures in an instructional setting. This helps the current research by emphasizing the necessity of early and explicit kinesthetic interventions to prevent long-term linguistic delays in learners with a complete visual challenge.

## 5. Methodology

### 5.1. Research Design and Participant Selection

This study employs a qualitative case study design (Creswell, 2013). This approach was chosen to provide a detailed, objective account of how beginner learners interact with kinesthetic strategies in an authentic secondary school environment. The participant selection process involved a purposive sample of seven completely visually challenged students, aged 14 to 15, who were in their third year of secondary school in Morocco and their first year of English study. Additionally, the study included one specialized EFL teacher with five years of experience in inclusive education for students with a complete visual challenge. The teacher served as a key informant, providing professional insights into the practical application and feasibility of the proprioceptive model within a standard Moroccan classroom setting.

### 5.2. Data Collection Instruments

Data were collected through longitudinal classroom observations and a semi-structured interview. Over a six-week period, 10 English lessons were observed using a systematic observation protocol designed to track how students utilized their limbs, posture, and physical boundaries to map spatial prepositions such as "between," "on," "above," and "in." Following the observation period, a 45-minute audio-recorded interview was conducted with the specialized EFL teacher. This interview aimed to explore the teacher's perceptions of the practical successes and pedagogical challenges encountered when implementing the "body-as-image" techniques. This dual-instrument approach allowed for the triangulation of observed student behaviors and the teacher's expert instructional perspective.

### 5.3. Data Analysis: Thematic Analysis

The data were analyzed using the rigorous six-phase reflexive thematic analysis framework established by Braun and Clarke (2014). In Phase 1: Familiarization, the researcher immersed themselves in the dataset through repeated reading of field notes and listening to interview transcripts to identify preliminary patterns and analytic hunches. Phase 2: Systematic Coding involved identifying and labeling meaningful segments of data with concise identifiers, such as "motoric anchoring" and "spatial anxiety reduction," creating the essential building blocks for the analysis. In Phase 3: Generating Initial Themes, the researcher examined the codes to identify broader patterns of meaning, looking for central organizing concepts that connected related data segments. Phase 4: Developing and Reviewing Themes involved a rigorous check of the candidate themes against both the coded extracts and the entire dataset to ensure they accurately and coherently represented the students' learning experiences. In Phase 5: Refining and Naming, each theme was defined and named to clearly articulate its scope and contribution to the research questions, finalizing themes like "Kinesthetic Anchoring" and "Spatial Transition." Finally, Phase 6: Writing Up involved the production of a coherent narrative that wove together evidence from observations and teacher transcripts to support the study's findings and address the core research questions.

## 6. Findings:

### Theme 1: Kinesthetic Anchoring of Prepositions

The analysis confirmed that beginner students effectively used their limbs and physical boundaries as functional anchors for new spatial vocabulary. This process provided the "metric stability" that sighted students typically derive from visual prompts in textbooks. For example, the differentiation between "on" and "above" became instantaneous when students were asked to perform a physical touch associated with "on" versus a suspended gesture for "above." During the introduction of "on," the teacher instructed students to place their hands directly on their desks, creating a clear tactile sensation of contact. For "above," students held their hands 20 centimeters higher, experiencing the sensation of "upness" without physical contact. The teacher observed that "the movement became their textbook image," providing an immediate conceptual clarity that verbal definitions alone failed to achieve. This tactile feedback loop allowed students to encode the preposition as a physical coordinate, anchoring the linguistic label to a concrete bodily experience.

## **Theme 2: Transition from Egocentric to Allocentric Space**

A major finding was the role of the body in facilitating the transition from egocentric (body-centered) to allocentric (object-centered) spatial coding. Initially, students exhibited significant difficulty describing the location of external objects, such as a pen in relation to a book. However, by first physically standing "between" two large desks, they were able to internalize the sensation of being positioned in the middle of two boundaries. Once this egocentric experience was established, the students were able to project that motoric understanding onto inanimate objects, describing the pen as being "between" two books with 100% accuracy. This suggests that for completely visually challenged students, the body acts as the "first image" or primary scaffold. By enactment of the preposition through their own movement, students were able to master complex spatial syntax and eventually manipulate spatial relations between objects they could not see simultaneously.

## **Theme 3: Reduction in Spatial Anxiety and Increased Classroom Confidence**

The implementation of proprioceptive strategies resulted in a marked reduction in spatial anxiety among the participants. In standard ocularcentric lessons, students often felt forced to engage in "abstract guessing" when asked about positions in unseen pictures, which increased cognitive load and fear of error. The proprioceptive feedback loop provided an objective self-correction mechanism; for instance, when a student could physically feel that their hand was "under" a chair, they gained a sense of certainty that replaced the "contextual void" of the curriculum. The teacher noted that completely visually challenged students who were previously hesitant to participate became vocal and proactive, stating that the "kinesthetic certainty" empowered them to volunteer more frequently. The ability to verify their own accuracy through motor-sensory feedback significantly boosted their confidence, fostering a more independent and inclusive learning environment where students felt they were active constructors of meaning.

## **7. Discussion**

The results of this study provide strong evidence for the Embodied Cognition hypothesis, which posits that language meaning is fundamentally grounded in motor-sensory interaction (Barsalou, 2008). In the absence of visual input, the brain's motor cortex provides the necessary "spatial stability" that vision normally offers to sighted learners (Pulvermüller, 2018). The high success rate in "body-anchoring" tasks demonstrates that the "body-as-image" is not merely a compensatory tool but an essential epistemic resource for linguistic development. This shift in pedagogical paradigm from "seeing" to "being" ensures that completely visually challenged students can construct mental models of spatial relations that are just as accurate as those of their sighted peers. By physicalizing prepositions, Moroccan secondary students optimize their acquisition of spatial syntax through a "pseudo-visual sensation," where motoric feedback confirms the conceptual accuracy of their linguistic output (Hickok & Houde, 2010).

Furthermore, the transition from egocentric to allocentric space observed in this study aligns with the model of "Proprioceptive Resonance." This model suggests that meaning is generated through a "readiness to act," where shared internal axial coordinates (vertical, horizontal, and sagittal) structure the emergence of symbolic thought (Pulvermüller, 2018). When a student performs a gesture to represent "through" or "across," they are engaging in a dynamic synchronization of embodied states that facilitates language acquisition. This supports the claim that the coordination of syntax may have evolved from embodied motor schemata rather than abstract grammatical rules. The reduction in spatial anxiety also proves that kinesthetic learning addresses the psychosocial impact of vision loss, making the classroom a predictable and supportive space for completely visually challenged students (Tahiri, 2023). By replacing visual scaffolds with proprioceptive ones, educators can bypass the didactic barriers in the Moroccan ELT system and fulfill the goals of "Strategic Vision 2015-2030" for inclusive and equitable education.

## **8. Recommendations**

The Moroccan Ministry of National Education should formally incorporate "physicalization protocols" into the beginner EFL curriculum for students with a complete visual challenge. This kinesthetic reform should be supported by professional development workshops for secondary school teachers, focusing on "Proprioceptive Pedagogy" to teach staff how to use the students' own bodies, the classroom's physical architecture, and real-life objects (realia) as primary didactic resources. By prioritizing hands-on, experiential learning and providing students with opportunities to self-correct through motor-sensory feedback, the Moroccan educational system can move away from ocularcentric assessments toward a more equitable and multimodal model of language acquisition.

## **9. Conclusion**

This research argues that the absence of the image is not a barrier to acquisition, but a call for a "proprioceptive turn" in pedagogy. For completely visually challenged students in Moroccan secondary schools, the body is the ultimate grammatical image. By leveraging motor-sensory feedback loops, educators can optimize the acquisition of spatial syntax for completely

visually challenged beginners, ensuring they are active participants in the construction of linguistic meaning. Embracing the "Proprioceptive Paradigm" ensures a truly objective and inclusive future for English Language Teaching in Morocco, empowering all learners to build their own maps of the world through the power of movement and sensation.

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