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Neuroeducation in Moroccan Secondary Schools: Teachers' Perceptions, Practices, and Challenges in Life and Earth Sciences

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Abstract

Neuroeducation, at the intersection of neuroscience, cognitive psychology, and pedagogy, offers brain-based approaches to optimize learning conditions by strengthening learners' attention, memory, and motivation. In Morocco, despite efforts to improve the quality of teaching and learner achievement in various scientific disciplines, numerous studies show that major difficulties persist, namely cognitive obstacles such as limited abstract thinking skills and problems with attention and memory. Faced with this situation, research shows that knowledge from the neuroscience of learning can inform concrete pedagogical choices, helping teachers understand how

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attention, memory, and motivation work, and transforming the way teaching sequences are organized to better take into account the diversity of profiles. In this context, this study aims to examine Moroccan life and earth science teachers' perceptions, current practices, and the challenges they face in implementing neuroeducational strategies. A quantitative survey was conducted with 71 secondary school teachers in the Marrakech-Safi and Casablanca-Settat regions. Data were collected using a validated questionnaire. The results indicate a generally positive perception, with 81% of participants recognizing the effectiveness of neuroeducational techniques. However, effective implementation remains limited by structural constraints such as overcrowded classrooms and a lack of specific training. While providing original insights into the Moroccan context, the study is limited by its sample size and the declarative nature of the data. These findings highlight the urgent need for integrating neuroeducation into teacher training programs to bridge the gap between theoretical knowledge and classroom application.

Keywords: Neuroeducation, Teaching and Learning, Life and Earth Sciences, Secondary Education, Morocco

1. Introduction

The Moroccan education system has instituted numerous reforms intended to enhance teaching quality and student learning outcomes in various scientific disciplines (MEN, 2015). Notably, Life and Earth Sciences (SVT), which occupy a central position in secondary school curricula. This discipline is essential not only for the scientific training of learners but also for the development of transversal skills such as observation, analysis, and scientific reasoning.

Nonetheless, despite these protracted efforts, student performance in science remains below national expectations and strategic targets. The results of national and international assessments, such as PISA (OECD, 2019) and TIMSS (IEA, 2020), consistently place Morocco among the lowest-ranked countries in science, revealing significant gaps in both cognitive and methodological competencies. Furthermore, the national PNEA assessment (CSEFRS, 2021) indicates that the majority of third-year middle school students have not assimilated more than 38% of the science curriculum content. These results reflect not only difficulties inherent in the complexity of the concepts addressed but also limitations in contemporary teaching practices. Recent research highlights that most teachers adapt their practices primarily to available pedagogical tools without sufficiently addressing the cognitive diversity of learners, which consequently diminishes student engagement (Bassou et al., 2023). This evidence suggests that science

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education continues to rely heavily on traditional methods, centered on textbooks and the direct transmission of knowledge.

In this context, learners often remain passive, with limited opportunities to actively participate in the construction of knowledge. Furthermore, the integration of visual aids, digital tools, and experimental activities, which are inherently suited to the specificities of the discipline, remains rare. This lack of pedagogical diversity, combined with insufficient contextualization of content, renders learning overly abstract and frequently discouraging for learners. As a consequence, their motivation, understanding, and ability to consolidate knowledge are severely constrained

Building upon these findings, evidence from cognitive neuroscience has identified fundamental pillars for optimizing learning processes, specifically emphasizing the roles of attention, working memory, motivation, and emotional regulation in long-term knowledge consolidation (Campedel, 2017; Tokuhama-Espinosa, 2018). These scientific advances have facilitated the emergence of neuroeducation—an interdisciplinary field that bridges neuroscience, psychology, and education (Ansari et al., 2012). This approach aims to align pedagogical strategies with the brain's natural learning mechanisms to make instruction more effective, sustainable, and engaging (Brault Foisy, 2022). International research increasingly demonstrates that when teachers understand how the brain processes information, they are better equipped to implement differentiated instruction and move beyond traditional transmissive methods (Schwartz et al., 2019; Blanchette Sarrasin et al., 2020).

Consequently, the present study investigates the actual role played by neuroeducation techniques in the practices of Moroccan Life and Earth Sciences (SVT) teachers. It specifically aims to assess their perceptions and use of these techniques, while identifying the structural and pedagogical obstacles encountered during their implementation**.** By doing so, this research seeks to provide original insights that could inform future teacher training programs and educational policies in Morocco.

2. Methods

2.1. Type of research

This research employs an exploratory quantitative approach, operationalized through a structured questionnaire specifically designed to align with the study's objectives. The instrument aimed at identifying the foundational knowledge, conceptual representations, and actual pedagogical practices of science teachers regarding the integration of neuroeducation techniques.

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2.2. Target audience

The survey was conducted among a sample of secondary school science teachers (N=71) within two administrative regions of Morocco: Marrakech-Safi and Casablanca-Settat. Table 1 illustrates their primary demographic characteristics. The sample exhibits a slight male predominance (52.11%), and over half of the participants are aged between 21 and 30 (54.93%), reflecting a relatively young teaching population.

Regarding professional seniority, a majority of the teachers (51.11%) have accrued less than five years of experience. In terms of academic qualifications, the most prevalent credential is the bachelor's degree (56.34%). The participants possess diverse professional training profiles, with a notable concentration of graduates from Regional Centers for Education and Training (CRMEFs), representing 43.66% of the sample.

Table 1: Demographic characteristics of teachers surveyed

Parameter	Assign	Percentage %
Genre	Male	52,11%
	Feminine	47,89%
Age	21-30	54,93%
	31-40	30,99%
	41-50	4,23%
	51-60	9,86%
Degree	DEUG	4,23%
	Bachelor	56,34%
	Master	39,34%
	Doctorate	0%
Training	CPR	14,08%
	CFI	4,23%
	ENS, ESEF	18,31%
	CRMEF	43,55%
	Other	19,72%
Seniority	Under 5 years old	51,11%
	Between 5 and 10 years old	22,54%
	More than 10 years	25,35%
Teaching cycle	High school	66,20%
	Secondary qualification	33,80%

2.3. Research tools and validity

Our study employed a questionnaire comprised of three primary axes as a research tool: first, teachers' conceptual perceptions of neuroeducation; second, their integration of neuroeducational techniques within the didactics of Life and Earth Sciences; and third, the structural and pedagogical challenges they encounter during implementation (Table 2).

To ensure the instrument's validity, the questionnaire items were developed based on an extensive review of neuroeducation literature, particularly regarding brain-based learning strategies and teacher professional

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representations. Furthermore, the tool underwent a content validity check by a panel of pedagogical experts and researchers in science didactics, who reviewed the items for clarity, relevance, and theoretical alignment. Finally,a Cronbach's alpha test was performed in order to verify the internal consistency of the questionnaire, with an index of $\alpha = 0.9$, indicating excellent reliability.

Table 2: Items from the questionnaire for collecting data on neuroeducational techniques

Items	Questions	Objectives
Axe 1	Q8	Identify teachers' knowledge of neuroeducation
Axe 2	Q9 à Q15	Identify perceptions of the effectiveness of neuroeducational techniques, their actual use in the classroom, and their adaptation according to grade level or teaching context.
Axe 3	Q16 à Q18	Identify the difficulties and obstacles encountered when implementing the techniques, as well as the needs expressed by teachers.

2.4. Data processing

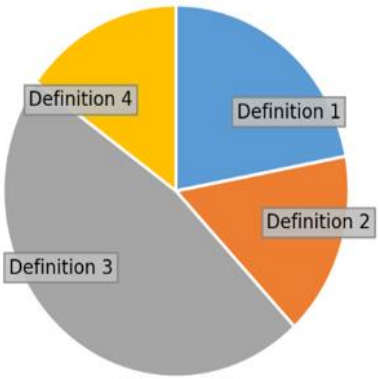
To analyze and process the data collected from the questionnaire, statistical analysis was performed using Microsoft Excel (version 2016) and JASP software (version 0.19.3.0). These tools were utilized to ensure rigorous statistical processing and to generate descriptive and analytical insights aligned with the study's objectives.

3. Results

The analysis of the questionnaire results is organized around three thematic areas corresponding to the main objectives of this study.

3.1. Teachers' perceptions of neuroeducation

The results indicate that 45% of respondents possess a comprehensive understanding of neuroeducation, correctly identifying it as an interdisciplinary field. Conversely, the 55% who held approximate or reductive views often confused neuroeducation with general neuroscience or simple technological tool usage. This conceptual gap highlights a critical need for standardized neuroeducational literacy among SVT teachers to prevent the proliferation of neuromyths in the classroom.



Def 1 : *It is the study of the brain mechanisms involved in learning.*
Def 2 : *It is a technique that seeks to understand how students learn best.*
Def 3 : *It is a discipline that combines neuroscience, cognitive psychology, and educational science to improve teaching and learning.*
Def 4 : *It involves using technological tools to stimulate the learning brain.*

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3.2. Implementation of neuroeducation techniques

Figure 2 reveals a significant discrepancy between teachers' awareness of techniques and their actual implementation. For example, while 73% are aware of the 'error approach,' only 45% utilize it in practice. This 'knowledge-to-practice' gap indicates that theoretical awareness is not sufficient to overcome classroom constraints. Techniques requiring less structural change, such as mental imagery (52% use) and mind mapping (43% use), are more frequently adopted than active breaks (0% use), which may be perceived as disruptive in a traditional curriculum-driven environment.

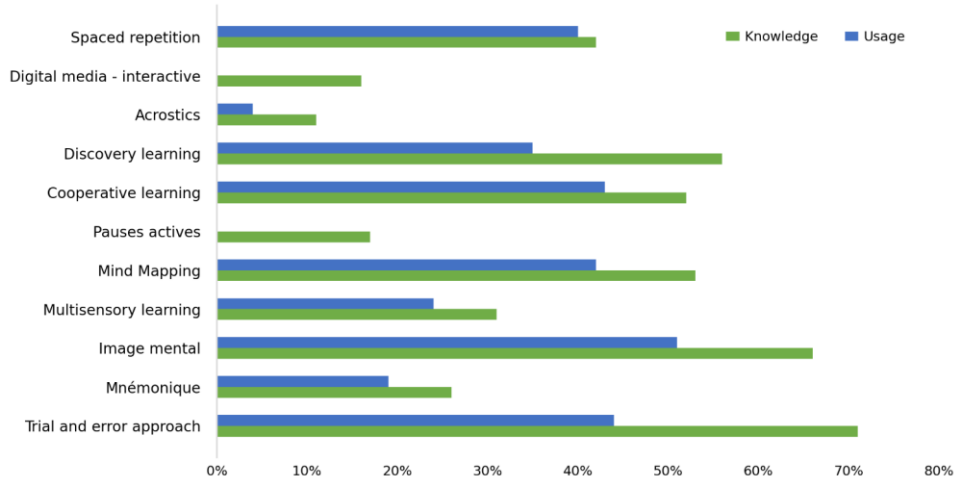

Figure 2: Percentages of reported knowledge and actual use of neuroeducational techniques

3.3. Relevance of techniques according to the teaching cycle

The teachers surveyed were also asked to assess the relevance of the techniques according to the teaching cycle and class size. The results are shown in Figure 3.

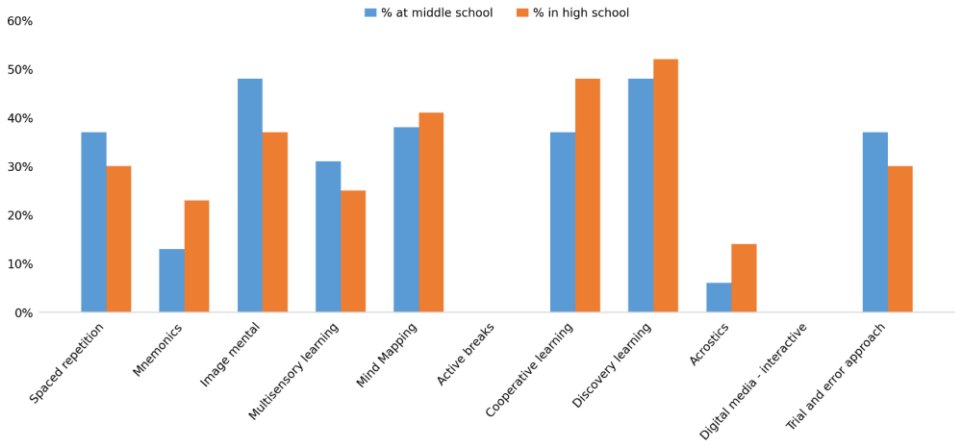

Figure 3: Percentages of reported relevance of neuroeducational techniques by educational level

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The most relevant techniques in middle school are mental imagery (48%), spaced repetition (38%), error correction (38%), and multisensory learning (31%). In high school, the most relevant techniques are discovery learning (52%), cooperative learning, and mind mapping (42%).

3.4. Obstacles and challenges encountered by the teachers surveyed and areas for improvement

The teachers surveyed identified several obstacles limiting the effective integration of neuroeducational techniques into their practices. The responses are shown in Figure 4.

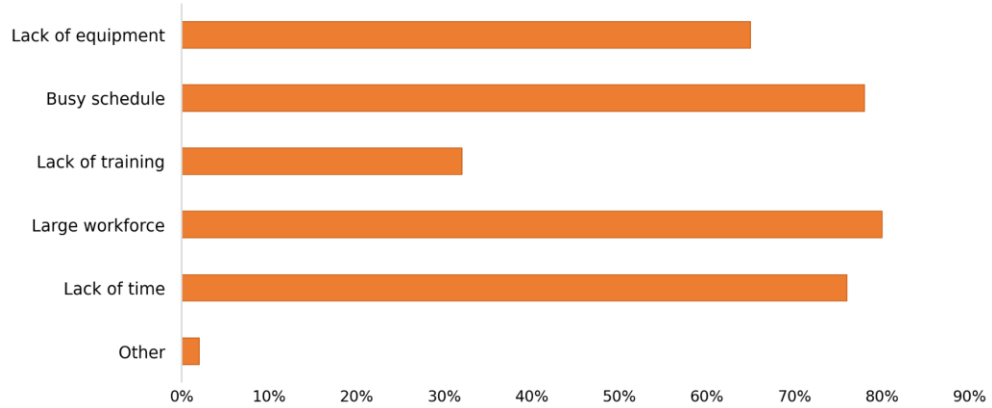

Figure 4: Challenges reported by teachers in integrating neuroeducational techniques into their practices

The most frequently cited challenges are therefore related to structural teaching conditions: overcrowded classrooms, a dense curriculum, and lack of time, which limit the possibility of introducing more interactive or differentiated teaching approaches. Although a lack of training is also mentioned, it is less frequently cited.

The "other" category, although a minority (1.5%), reveals additional pedagogical concerns. Teachers mention: the low level of prerequisites among learners, lack of discipline in the classroom, lack of motivation to learn, and difficulties related to mastery of the French language.

These contextual factors add a psycho-pedagogical and cognitive dimension to the perceived obstacles and deserve special attention in the analysis of teaching practices.

Teachers also identified a set of levers to facilitate the integration of techniques.

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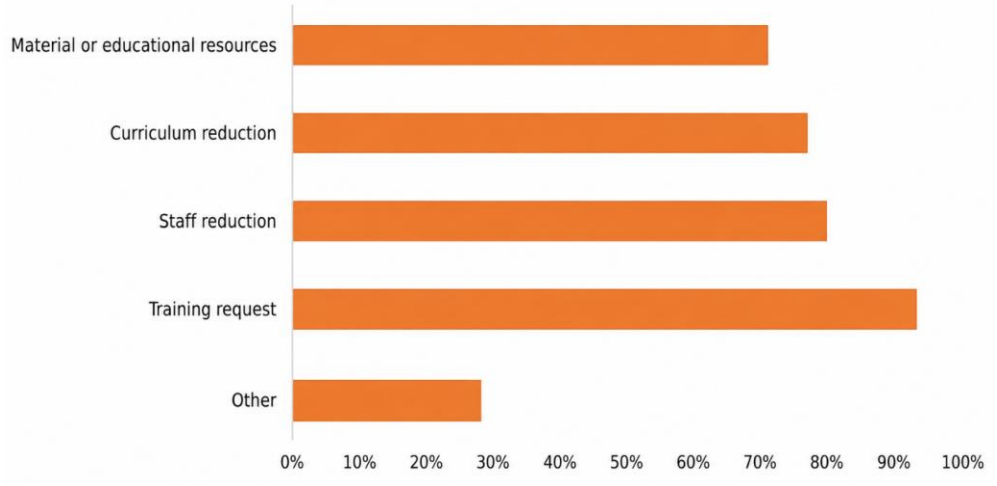

Figure 5: Teachers' suggestions for promoting the use of neuroeducational approaches

A very large majority of teachers (93%) express the need for specific training in neuroeducational approaches, confirming both their interest and their need for methodological support. Added to this is the desire for more favorable teaching conditions, particularly in terms of class sizes, workload, and access to resources.

The "other" category, mentioned by 29% of respondents, highlights several key expectations and recommendations for better incorporating neuroscience techniques into teaching, namely raising awareness among teachers of the importance of neuroeducation and developing their awareness of its contributions to teaching practice, and providing ongoing training for teachers on strategies based on brain plasticity.

4. Discussion

4.1. Conceptual representations and the risk of neuromyths

While 45% of participants correctly identify neuroeducation as an interdisciplinary field, the fact that 55% hold reductive views is a point of concern. This conceptual ambiguity often serves as fertile ground for "neuromyths"—scientifically unfounded beliefs about the brain.

This risk is corroborated by recent local evidence from Kouchou et al. (2025), whose research on Moroccan teachers highlights a high adherence to myths, notably that 92.8% of surveyed teachers believe in the effectiveness of teaching tailored to "learning styles". These findings are strongly supported by the cross-national study of Adiguzel et al. (2025) conducted across 11 countries. Their research demonstrates that neuromyths remain alarmingly prevalent worldwide, with an average of over 90% of teachers still believing in the "learning styles" myth, regardless of their cultural or geographical

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background. This global persistence, as noted by Blanchette Sarrasin et al. (2020), emphasizes that without a solid neuroscientific foundation, teachers are likely to adopt practices that lack empirical validity.

4.2. The knowledge to practice Gap

The discrepancy between the awareness (73%) and application (45%) of the 'error approach' highlights a significant 'knowledge-to-practice' gap. According to Howard-Jones (2014), this gap is often bridged by teachers adopting 'low-stakes' tools like mind mapping (43%) or mental imagery (52%), which require minimal structural change. Conversely, the 0% usage of 'active breaks' reflects a conflict with the rigid instructional time management often seen in traditional systems. This suggests that while Moroccan SVT teachers are theoretically receptive, the transition to 'neuro-compatible' classrooms is hindered by established pedagogical habits, a phenomenon also documented in broader science education research (Ansari et al., 2012)

4.3. Study limitations and future directions

It is important to acknowledge the limitations of this research, notably the sample size (N=71) and its declarative nature. Future research should shift from perceptions to direct classroom observations to evaluate the real-time impact of neuroeducational interventions on student achievement in SVT.

Conclusions

This research aimed to explore the perceptions, uses, and needs of science teachers with regard to neuroeducation, while assessing the concrete impact of an approach based on its principles. The results of the questionnaire reveal several significant findings.

Our study revealed that teachers generally have a good understanding of neuroeducation, even if some confusion remains as to its precise definition. They perceive neuroeducational techniques as effective and relevant, and several of them, such as mental imagery, mind mapping, and discovery learning, are already integrated into teaching practices. However, Material and organizational obstacles, such as overcrowded classrooms, lack of time, or lack of training, hinder broader and more systematic implementation. Teachers, therefore, express a clear need for support and more favorable conditions for integrating these approaches.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The authors did not obtain any funding for this research.

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Declaration for Human Participants: This study was conducted in accordance with the principles of the Declaration of Helsinki. Participation was voluntary, and all responses were collected anonymously and treated confidentially.

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