

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 approaches based on brain function to optimize learning conditions in schools. It provides concrete tools to strengthen 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 (Chakour et al., 2019). Faced with this situation, research shows that knowledge from the neuroscience of learning

can inform concrete pedagogical choices, helping teachers understand how attention, memory, and motivation work, and transforming the way teaching sequences are organized to better take into account the diversity of profiles. (Schwartz et al., 2019). In this context, this study examines Moroccan life and earth science teachers' perceptions of the potential contribution of neuroeducational techniques to improving secondary school students' engagement and understanding. To this end, a questionnaire survey was conducted among SVT teachers in Morocco (N=71) to collect data on their perceptions, practices, and needs for improvement. The results indicate a positive perception of these approaches, with approximately 81% agreeing with the effectiveness of neuroeducational techniques, but their application is still limited by organizational and structural constraints.

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

Introduction

The Moroccan education system has implemented numerous reforms with the aim of improving the quality of teaching and learners' achievements in various scientific disciplines. (MEN, 2015), particularly Life and Earth Sciences (SVT), which occupy a central place in secondary school curricula. This discipline is essential not only for the scientific training of learners, but also for the development of cross-curricular skills such as observation, analysis, and scientific reasoning.

However, despite these ongoing efforts, learners' performance in science remains below national expectations and targets. The results of national and international assessments, such as PISA (OECD, 2019) and TIMSS (IEA, 2020), place Morocco among the lowest-ranked countries in science, revealing significant gaps in both cognitive and methodological skills. Furthermore, the national PNEA assessment (CSEFRS, 2021) indicates that most third-year middle school students have not assimilated more than 38% of the content of the science curriculum. These results reflect not only difficulties related to the complexity of the concepts covered, but also certain teaching practices adopted by teachers. One study highlights that the majority of teachers adapt their practices to the teaching and learning tools available, without taking into account the cognitive diversity of learners, which can limit their engagement. (Bassou et al., 2023). This research reveals that science education still relies on traditional methods, centered on textbooks, documentation, and the direct transmission of knowledge.

In this context, learners often remain passive, with few opportunities to actively participate in the construction of knowledge. Furthermore, the use

of visual aids, digital tools, or experimental activities, which are well suited to the specificities of the discipline, remains rare. This lack of diversity in teaching approaches, combined with a weak contextualization of content, makes learning more abstract and sometimes discouraging for learners. As a result, their motivation, understanding, and ability to consolidate knowledge are limited.

In light of these findings, data from cognitive neuroscience has identified powerful levers for improving learning processes, highlighting the importance of attention, working memory, motivation, and emotion in knowledge consolidation. (Campedel, 2017). These advances have given rise to a new educational approach: neuroeducation, which aims to adapt teaching to brain mechanisms of learners, in order to make learning more effective, sustainable, and engaging (Brault Foisy, 2022).

In this context, our study examines the actual role played by neuroeducation techniques in the practices of science teachers. It aims to assess their perceptions and use of these techniques, and to identify the difficulties encountered in implementing them.

Methods

Type of research

This research is based on an exploratory and quantitative approach, implemented through a questionnaire designed according to the study's objectives, aimed at identifying the knowledge, representations, and actual practices of science teachers regarding the use of neuroeducation techniques.

Target audience

The survey was conducted among secondary school science teachers (N=71) in two regions of Morocco (Marrakech-Safi and Casablanca-Settat). Table 1 shows their main demographic characteristics. The majority are men (52.11%), and more than half are aged between 21 and 30 (54.93%), indicating a relatively young teaching population. In terms of seniority, more than half of the teachers (51.11%) have less than five years' experience. In terms of academic qualifications, most hold a bachelor's degree (56.34%) with diverse professional training profiles, and a predominance of graduates from regional centers for education and training (CRMEFs) (43.66%).

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%

Search tools

Our study used a questionnaire consisting of three items as a research tool: teachers' perceptions of neuroeducation, their use of neuroeducational techniques in teaching life and earth sciences, and the difficulties they encounter in implementing them (Table 2). A Cronbach's alpha test was performed carried out 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.

Data processing

To analyze and process the data obtained from the questionnaire, we used Excel (version 2016) and JASP (version 0.19.3.0) for statistical processing.

Results

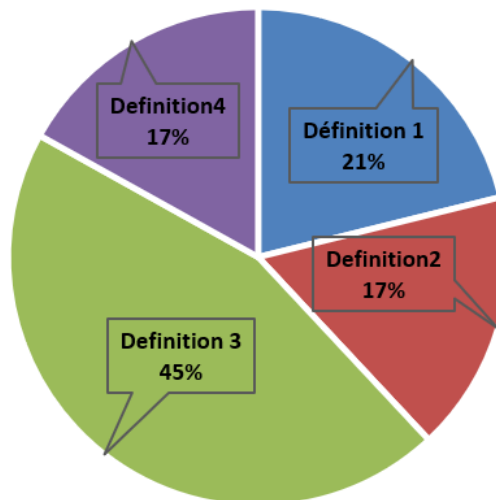
The analysis of the questionnaire results is organized around three thematic areas corresponding to the main objectives of this study.

Teachers' perceptions of neuroeducation

The results show that 45% of respondents consider neuroeducation to be an interdisciplinary field at the crossroads of cognitive psychology, neuroscience, and pedagogy, which is the most comprehensive definition and the one that most closely matches descriptions found in scientific literature. This majority proportion reflects a generally adequate understanding of the concept among a significant proportion of the teachers surveyed.

On the other hand, 55% of teachers suggested more approximate or reductive conceptions of the concept, which do not reflect all of the theoretical and pedagogical dimensions covered by neuroeducation.

Figure 2: Conceptual representation of neuroeducation according to the teachers surveyed



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.

Implementation of neuroeducation techniques for surveyed teachers

This axis shows the awareness rate (A) and the effective implementation rate (I) of several neuroeducational techniques. Figure 3 highlights varying discrepancies between the awareness rate and the effective use of neuroeducational techniques by the teachers surveyed.

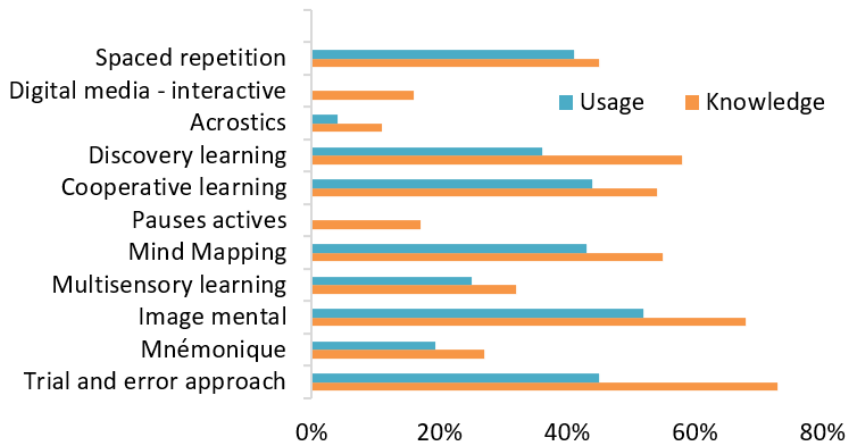


Figure 3: Percentages of reported knowledge and actual use of neuroeducational techniques

Certain techniques stand out due to a high level of awareness accompanied by a relatively high level of application, such as mental imagery (68% K vs. 52% U) and mind mapping (55% K vs. 43% U). Others, although well known, are used to a more limited extent: this is the case with the error approach (73%K vs. 45%U) and discovery learning (58%K vs. 36%U). Finally, some methods remain very marginal, with extremely low awareness and use, such as active breaks (17%K awareness but no reported implementation).

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 4.

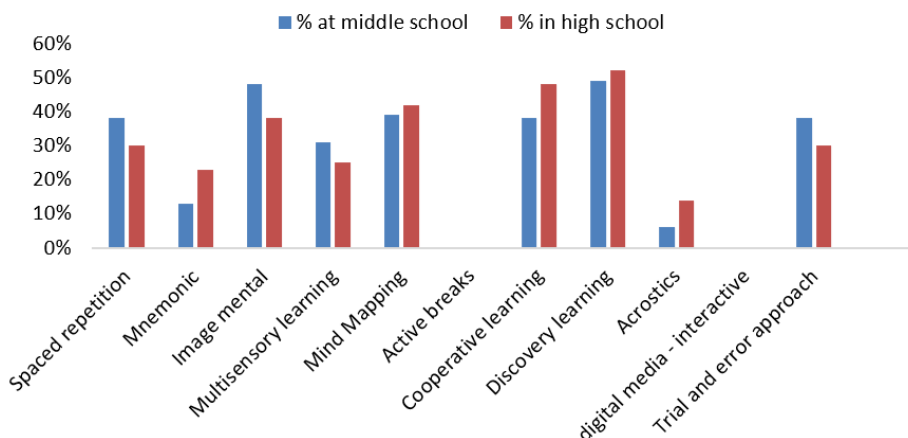


Figure 4: Percentages of reported relevance of neuroeducational techniques by educational level

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%).

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 5.

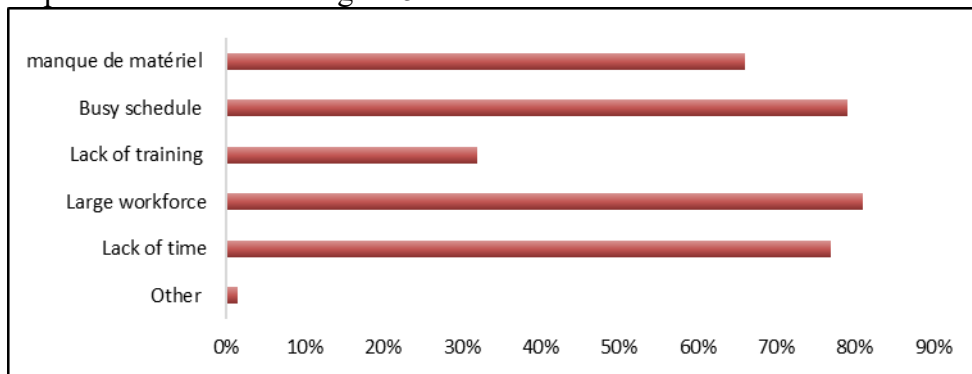


Figure 5: Challenges reported by teachers in integrating neuroeducational techniques into their practices

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.

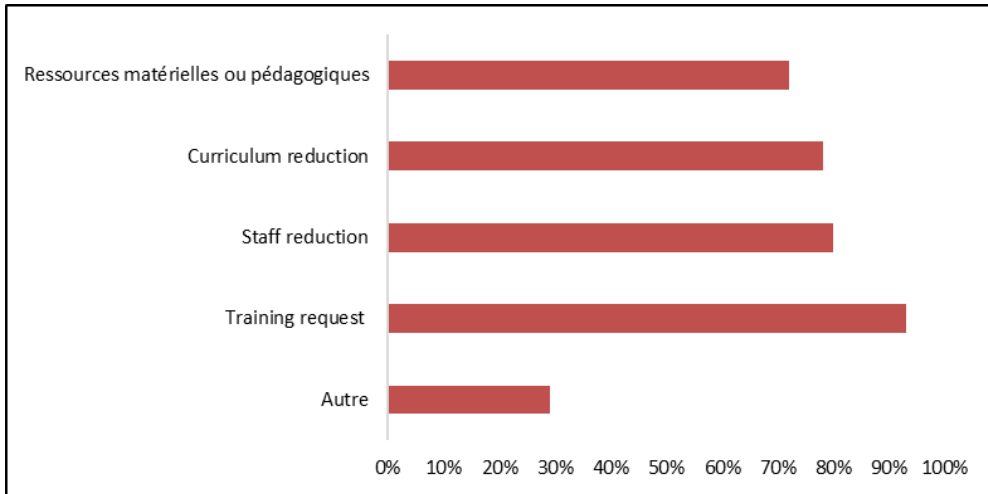


Figure 6: Teachers' suggestions for promoting the use of neuroeducational approaches

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.

Discussion

The results of the questionnaire show that 45% of science teachers have a generally correct understanding of neuroeducation. However, nearly half of teachers demonstrate a more partial or sometimes incomplete understanding of the concept. Some reduce it to the study of brain mechanisms, while others associate it solely with specific techniques or the use of technological tools. These findings are consistent with the 2012 research by Dekker et al., which highlights teachers' vulnerability to misconceptions or neuromyths, despite a clear interest in neuroscience [41]. This observation is also in line with a study that highlighted an alarming prevalence of neuromyths among Moroccan teachers. More specifically, 92% of them still adhere to the scientifically unfounded myth of "preferred learning styles" [42]. These studies confirm that persistent neuromyths, such as the 10% brain myth, can lead to inappropriate teaching practices. Several studies also show the need to understand brain mechanisms in order to adapt

teaching practices to learners' needs [13]. This diversity of representations reflects an uneven understanding of the field of neuroeducation, which can influence how teachers view and adopt their teaching practices. It also highlights the need for pedagogical support and more in-depth training to standardize knowledge and facilitate the integration of neuroeducational techniques into teaching.

Conclusions

The aim of this research was 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.

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