

# Factors that Facilitate or Impede the Implementation of Neuroeducational Principles: Perspectives from Preschool and Primary School Teachers

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**ABSTRACT**— Through professional learning communities comprising preschool and primary school teachers, we investigated factors that facilitate or impede the implementation of neuroeducational principles, including repeated neuronal activation, active learning, spaced learning, feedback and mindset. Findings from this small-scale qualitative study indicate that general factors, such as classroom management and curriculum overload, may impede the translation of research knowledge into teaching practice. Moreover, our study revealed that teachers also encounter principle-specific barriers. These findings underscore the necessity for sustained implementation, as the impact on learning outcomes may not be immediately evident, even when applying well-established principles such as spaced learning and feedback.

understanding of learning processes is likely to provide additional avenues to improve teaching, enhance understanding of learning disabilities and boost academic achievement (for a review, see Ozernov-Palchik et al., 2024). Despite developments in the field of neuroeducation (also called Mind, Brain and Education) and teachers' enthusiasm for its recommendations (Pickering & Howard-Jones, 2007), neuroeducational research knowledge remains poorly integrated into initial teacher training curricula (OECD, 2007; Pasquinelli, 2011). Teachers' opportunities to encounter this knowledge are largely unequal and based on isolated initiatives, such as occasional conferences (Stafford-Brizard, Cantor, & Rose, 2017). Moreover, despite teachers' enthusiasm and their attendance at these conferences, relatively little is known about how they assimilate neuroeducational research knowledge (Privitera, 2021), nor what practices or strategies they implement in their classrooms, which barriers they encounter and, ultimately, what outcomes they observe in their students.

Over the past two decades, new methodological tools from neuroscience and cognitive psychology have been employed to study and characterize the cognitive and cerebral processes underlying learning (Brault Foisy & Masson, 2022). Several international organizations (e.g., OECD, 2007) and numerous researchers posit that a better

Several studies have already identified general factors that impede teachers' use of research-based knowledge (see Broekkamp & van Hout-Wolters, 2007; Levin, 2013). These include time constraints (Tual, Lima, & Bianco, 2021), difficulties in finding, evaluating and applying relevant research (Wilson, Hemsley-Brown, Easton, & Sharp, 2005), insufficient support and guidance (Savignac & Dunbar, 2014) and a significant gap between teaching practices and research-based practices (Goigoux, Renaud, & Roux-Baron, 2021). Conversely, factors such as teachers' engagement and pedagogical leadership have been identified as promoting the successful implementation of

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research knowledge in teaching practices (Bissonnette & Boyer, 2021). While these factors may also apply to neuroeducational research knowledge, other, less explored factors may influence its adoption. Investigating these factors is crucial to better support teachers in implementing neuroeducational principles—general principles based on brain and learning sciences (Masson, 2020), from which are derived teaching strategies—in their classrooms. This could be particularly relevant for teachers working with young children, as fundamental learning is critical for subsequent learning and later academic achievement (Duncan et al., 2007).

We chose to investigate these factors through professional learning communities (PLCs). Grounded in a culture of collaboration, PLCs provide a unique opportunity for teachers and researchers to work together, with the ultimate goal of enhancing learning and children's academic achievement (Leclerc & Labelle, 2013). Specifically, the teachers involved in the PLCs aimed to: (1) expand their knowledge of neuroeducational research and (2) standardize their teaching practices as a team in light of research knowledge. Concurrently, the researchers sought to: (3) disseminate neuroeducational research knowledge in a context distinct from university courses or conferences and (4) better understand the factors that facilitate or impede the implementation of neuroeducational principles in teachers' practices. This paper primarily focuses on this last objective, which addresses the gap between neuroeducational principles and their practical implementation in classrooms.

**Table 1**  
Characteristics of PLC participants

<i>PLC #1</i> <i>Preschool teachers</i>	<i>PLC #2</i> <i>Primary teachers (1st and 2nd grade)</i>
4 participants (3 regular preschool teachers, 1 substitute teacher)	6 participants (3 1st grade teachers, 2 2nd grade teachers and 1 special needs teacher)
2 to 28 years of teaching experience	3 to 24 years of teaching experience
Variable prior knowledge related to mind, brain and education	Variable prior knowledge related to mind, brain and education

**Table 2**  
Relationship Between Meeting Components and PLCs objectives

<i>Components</i>	<i>PLC objectives</i>
1 Semi-structured group discussion about the implementation of principles and teaching strategies discussed in the previous meeting	Objective 4: Better understand factors that facilitate or impede the application of neuroeducational principles in teachers' practices
2 Presentation of new content (neuroeducational principles and associated teaching strategies)	Objective 1: Enhance teachers' knowledge of neuroeducational research Objective 3: Share neuroeducational research knowledge in a different context
3 Semi-structured group discussion about new content and implementation objectives	Objective 2: Standardize teaching practices as a team, in light of neuroeducational research knowledge

## METHODS

### Participants

Ten teachers from the same public school in the Greater Montreal area participated in this project, forming two PLCs (see Table 1). Two researchers, both doctoral students and lecturers in neuroeducation, also took part in the project. Small PLCs were chosen to foster a close collaboration between teachers and researchers (Leclerc & Labelle, 2013).

### Professional Learning Communities (PLCs)

The PLC activities consisted of formal gatherings held during the 2023–2024 school year, with teachers released from their regular duties to attend. Three half-day sessions were held for each PLC—in late September, mid-November and mid-March. These sessions were intentionally spaced to provide teachers with ample time to implement some of the proposed teaching strategies between sessions, as it has long been documented that mere exposure to theory is largely insufficient (Korthagen & Kessels, 1999). Building on the work of Tan and Nashon (2013) and Tan and Amiel (2022) on teacher professional development, each session followed a structured format divided into three components, with each component addressing one or more of our four objectives (see Table 2).

The sessions focused on five neuroeducational principles (see Masson, 2020), including repeated neuronal activation, active learning, spaced learning, maximizing feedback, fostering a growth mindset, as well as on neuromyths

(see Supplementary Material for details in Data S1). Each neuroeducational principle was introduced through the presentation of research findings, followed by concrete teaching strategies that could be directly applied in the classroom. During the presentation of neuroeducational principles, participating teachers were explicitly encouraged to ask questions and make connections to their own practices, as this is considered important for eventually transferring research knowledge into practice (Gutshall, 2020; Tan & Amiel, 2022). Following this, through a semi-structured group discussion, teachers were asked to select a specific teaching strategy to implement before the next session. By inviting them to set personal objectives, our aim was for each teacher to tailor their objectives to their existing knowledge of neuroeducation, their professional development needs and the context of their classroom. Moreover, because the group discussions could foster collaboration, it might encourage teachers to support one another in choosing their objectives and determining the steps needed to achieve them. Teachers were encouraged to persevere throughout the implementation process, with the understanding that sustained effort might increase the likelihood of observing outcomes in children.

Each subsequent session began with a semi-structured group discussion, during which teachers were asked to reflect on their implementation objectives and share their experiences. They were explicitly asked about what they had implemented, how they did it, how the implementation process went and whether they had encountered any specific obstacles or, conversely, elements that facilitated the implementation. This provided an opportunity for the researchers to offer feedback on the implementation, revisit theoretical aspects of the content covered in the previous session and address any questions or challenges raised by the teachers.

With the teachers' consent, all sessions were recorded for training and research purposes. This project received approval from the local ethics committee.

### Data Analysis

All the semi-structured group discussions were transcribed verbatim and coded using NVivo R1.7.2, employing a moderated inductive approach (Anadón & Savoie Zajc, 2009). The coding framework for the conceptual category analysis was initially based on Masson's (2020) neuroeducational principles. As the analysis progressed, emerging themes were incorporated to deepen understanding and provide a more nuanced interpretation of the data (Paillé & Mucchielli, 2021). To ensure the reliability of findings in line with Lincoln and Guba's (1985) confirmability criteria, the coding process was conducted by two independent coders.

## RESULTS

While teachers were asked about factors that both facilitate and impede the implementation of teaching strategies derived from neuroeducational principles, a significant portion of the coded responses (45/284) pertained to general rather than principle-specific factors (see Figure 1). Regarding impeding factors, the most frequently cited challenge was classroom management. One teacher explained, "The organizational and management aspects are demanding, redirecting students, trying to maintain their attention, restoring order" (Verbatim 05). Teachers also noted that diverse student needs within heterogeneous groups consume considerable time, further reducing opportunities for learning activities. Additionally, across both preschool and primary levels, teachers reported that extensive curriculum content leaves little time for implementing new teaching strategies. School materials pose another obstacle; primary school teachers find workbooks overly restrictive, although they noted that hands-on materials tend to engage students. The lack of familiarity with new teaching strategies also hinders implementation. As one teacher reflected, "It's about remembering to use these strategies and doing so frequently enough that they become second nature. Sometimes I remind myself, 'Yes, I should be doing that'" (Verbatim 02). Finally, teachers mentioned insufficient support and a shortage of qualified staff in schools as systemic barriers to implementation.

The data also reveal impeding factors specific to each neuroeducational principle (see Table 3). It is worth noting that some general and principle-specific impeding factors occasionally overlap. For example, exercise books are both a general impeding factor, as teachers say they are required to use them and a specific impeding factor for repeated neuronal activation and spacing principles, as they are not designed in accordance with these principles.

Regarding factors that facilitate implementation, the data indicate that teachers infrequently mentioned these directly, with the exception of maximizing feedback (see Table 3). Teachers noted that preschool classroom organization enables immediate feedback, while goal-oriented activities (e.g., board games and logic games) facilitate detailed task-

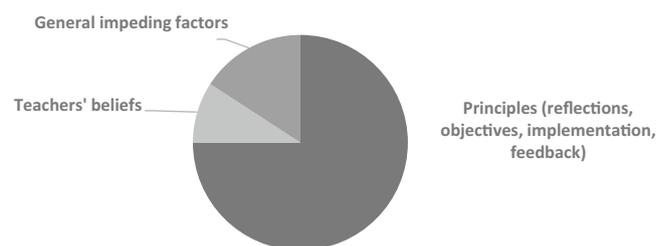


Fig. 1. Distribution of teachers' discussion time.

**Table 3**  
Factors that Facilitate and Impede Implementation of Neuroeducational Principles

<i>Neuroeducational principles</i>	<i>Facilitating factors</i>	<i>Impeding factors</i>
Repeated neuronal activation	–	<ul style="list-style-type: none"> <li>• Overloaded curriculum</li> <li>• Organization of primary school exercise book content</li> </ul>
Promoting active learning	–	<ul style="list-style-type: none"> <li>• Children's varied learning pace</li> <li>• Behavior and material management</li> </ul>
Spacing learning	–	<ul style="list-style-type: none"> <li>• Children's low level of autonomy</li> <li>• Organization of primary school exercise book content</li> </ul>
Maximizing feedback	<ul style="list-style-type: none"> <li>• Preschool classroom organization</li> <li>• Teacher circulating in the classroom</li> <li>• Goal-oriented activities</li> <li>• Activities in the child's zone of proximal development</li> <li>• Small groups</li> </ul>	<ul style="list-style-type: none"> <li>• Overly difficult or complex activities</li> <li>• Children's conflicts during preschool play</li> <li>• Child-led activities and play</li> </ul>
Fostering growth mindset	–	<ul style="list-style-type: none"> <li>• Children's family environment</li> </ul>

Note. Dashes indicate that teachers did not mention these factors in semi-structured discussions.

**Table 4**  
Relationship Between Teachers' Implementation of Neuroeducational Principles and Perceived Outcomes on Children's Learning

<i>Principles</i>	<i>Perceived Outcomes</i>	<i>Citations</i>
Repeated neuronal activation	Positive	"Yes, it's there, really there, you know. For real, it works. I'm just saying, that's the perfect example. But you know, we do it [counting] with leaps of two, leaps of five, leaps of ten, we do it ... I transpose it into anything, you know, it really works" (Verbatim 06).
Spacing learning	Fairly positive	"I found that compared to last year, they retained it better, so I didn't need to explain as much. When I was like 'what did we talk about last time?' they were able to tell me themselves, and often, they were able to finish my sentences" (Verbatim 02).
Maximizing feedback	No impact	"They were just as happy to see my 'bravo' as my 'bravo, you've drawn your letter well', but it probably has a beneficial effect in the longer term, but as is, I wouldn't say I've seen a difference" (Verbatim 06).

and strategy-oriented feedback. In some cases, the data suggest that facilitating factors may function as counterpoints to impeding ones. For instance, teachers observed that groups of children who are more motivated, mature or disciplined require less time for behavior management, thus increasing time allocated to learning activities.

The data also reveal two other noteworthy findings, specifically teachers' beliefs and their perceptions of children's learning outcomes. Teachers hold various beliefs, misconceptions or intuitions, often reinforced by their classroom observations. Some teachers expressed: "Despite neuroplasticity, you get the impression that some children have already crystallized" (Verbatim 03), "We can't ignore the fact that children today have increasing difficulty with self-regulation" (Verbatim 05) and "What's causing the prefrontal cortex to be less developed in 2023? Could it be

screens?" (Verbatim 05). These beliefs represented a significant portion of the discussions (26 citations, see Figure 1) and emerged in almost all meetings. The data suggest that, although observing outcomes was not an explicit objective, certain neuroeducational principles, such as repeated neuronal activation, resulted in outcomes that teachers spontaneously and more readily observed compared to others (see Table 4).

Lastly, the data reveal no clear trends or patterns associated with teachers' individual characteristics. Variables such as grade level (preschool or primary), years of teaching experience and prior knowledge of neuroeducational principles did not influence the facilitating and impeding factors identified by teachers, nor did they affect willingness to implement teaching strategies based on neuroeducational research.

## DISCUSSION

The aim of this study was to identify factors that facilitate or impede the implementation of neuroeducational principles in preschool and primary school teachers' practices. Consistent with the literature on teachers' adoption of new practices, general impeding factors were reported (Broekkamp & van Hout-Wolters, 2007). As numerous general factors impede teachers' engagement, this limited their feedback on the implementation of teaching strategies, thus restricting the identification of principle-specific factors.

A common general factor appears to be a lack of time. Indeed, time spent managing children's behavior, a dense curriculum, heterogeneous groups and existing course materials reduces the time teachers can devote to reflecting on and implementing new teaching strategies, even those likely to enhance learning. A relevant example of this is their perception of children's diverse needs, which were often viewed as obstacles rather than integral factors to address in the teaching and learning process. Classroom management also emerged as a significant concern, even among experienced teachers. This factor typically presents a major challenge for novice teachers, as experienced teachers usually focus more on learning (Ambroise, Toczek, & Brunot, 2017). The persistent focus on classroom management across teachers could be attributed to ongoing challenges of managing younger children or to mutual reinforcement of these concerns through group discussions.

Additionally, the data suggest that some teachers may have misinterpreted certain neuroeducational principles. For example, despite numerous and explicit explanations, some teachers continued to associate active learning primarily with physical movement, such as workshop activities (Cooperstein & Kocevar-Weidinger, 2004). This misunderstanding could explain why they view "behavior and material management" as a barrier to implementing active learning strategies, rather than recognizing that active learning can occur through various cognitive engagement methods. It is also possible that the relatively limited duration and number of sessions constrained some teachers' ability to fully grasp all the neuroeducational principles, particularly those with lower prior knowledge. Finally, the data yielded few facilitating factors. This might stem from researchers' focus on teachers' challenges, which may have encouraged sharing difficulties rather than success stories during discussions.

Overall, our results suggest that to effectively implement neuroeducation-based practices, teachers must overcome three hurdles: (1) general barriers to adopting research-based teaching methods, (2) specific obstacles related to neuroeducational principles and related teaching strategies and (3) the necessity of sustained implementation to observe learning outcomes. This last point is crucial; without visible results (or delayed outcomes, e.g., spaced

learning, Kornell, 2009), teachers may abandon neuroeducational approaches, potentially reinforcing their preexisting beliefs about learning. Lastly, our findings support the notion that limited knowledge about the brain fosters adherence to neuromyths (Murtaugh & JohnBull, 2017) and intuition-based teaching practices.

## LIMITATIONS AND CONCLUSION

This project involved establishing PLCs to foster close collaboration between researchers and teachers. Although the number of sessions was limited because of budgetary constraints, we believe that offering this type of support—combining theoretical training with objective setting and ongoing feedback throughout the school year for two teams of teachers—can effectively help educators integrate neuroeducation research into their practices. Additional tools, such as a teacher logbook, might have enabled teachers to document their application of neuroeducational principles more comprehensively. Furthermore, classroom observation sessions conducted by researchers could have encouraged teachers to apply the principles more rigorously. These observations would have allowed immediate, precise and individualized feedback between PLC sessions, rather than delaying feedback until the subsequent meeting, which relied on teachers' self-reported experiences.

It is important to emphasize that the perspectives shared here stem from teachers in a specific context and are not intended for broad generalization. Rather, they provide nuanced insights into the factors that facilitate or impede the implementation of teaching strategies derived from neuroeducational principles. Knowing these factors provides valuable reference points that can help us design better interventions for teachers. Lastly, future research could valuably investigate the long-term impact of such collaborative initiatives.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**Data S1.** Supporting Information.

## FUNDING INFORMATION

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## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

## ETHICS STATEMENT

This project was approved by a local ethics committee (Comité institutionnel d'éthique de la recherche avec des êtres humains de l'Université du Québec à Montréal, CIEREH # 2024–6509).

## DATA AVAILABILITY STATEMENT

Data are available upon request.

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