Neuromyths in Education: Comparing Perceptions Between Pre-service and In-service Teachers

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Abstract

In this study, participants were presented with pedagogical scenarios and asked to rate the effectiveness of two teaching practices: one based on a neuromyth and the other on evidence-based findings. Analyses showed that in-service teachers, compared to pre-service teachers, demonstrated both lower adherence to major neuromyths (learning styles, multiple intelligences, and brain gym) and stronger belief in evidence-based practices. This pattern was also observed within the in-service group, who favored evidence-based over neuromyth-based practices. Education level and teaching experience were negatively correlated with neuromyth endorsement and positively associated with recognition of effective teaching strategies. These findings suggest that Initial Teacher Education programs should explicitly address neuromyths early in training while facilitating knowledge exchange between experienced and novice teachers to accelerate pedagogical expertise development.

Key words

Neuromyths, initial teacher education, evidence-based practices, professional development, pedagogical expertise

Introduction

Knowledge about brain development and functioning has significantly advanced in recent years, particularly due to developments in neuroimaging techniques such as Magnetic Resonance Imaging (MRI) (Wu et al., 2021) and functional MRI (fMRI) (Glover, 2011). These developments have greatly sparked public interest in brain function, and the resulting "neurophilia" is currently expressed in various fields, such as neuromarketing, neuroarchitecture, neuromanagement (Grospietsch & Mayer, 2020), and neuroeducation (e.g. Grospietsch & Lins, 2021). However, in the educational context, the relevance of directly transferring neuroscience findings to classrooms remains open to debate (Sander, 2021).

While most teachers are enthusiastic about what neuroscience can offer education in terms of learning methods and strategies (Pickering & Howard-Jones, 2007; Serpati & Loughan, 2012), neuroscience-based principles are often misinterpreted and/or misunderstood, fostering the emergence of "neuromyths." In the educational context, neuromyths refer to "false ideas about how the brain works" (Howard-Jones, 2014). These false ideas can arise from misunderstandings, misinterpretations, or misquotations of established scientific facts used to justify the application of brain research in education (OECD, 2002).

Studies investigating the prevalence of neuromyths among education professionals have highlighted high levels of adherence to these erroneous beliefs (Tual et al., 2024), regardless of the cultural context in which the surveys were conducted (Blanchette Sarrasin et al., 2019; Ferreira & Rodríguez, 2022). These myths share a common trait as they categorize individuals and rely on the idea that tailoring instruction to students' individual characteristics is more effective than approaches that do not take these differences into account (Sander, 2021). Some of the most widespread neuromyths include statements such as "Adapting teaching to students' preferred learning style (e.g., visual, auditory, kinesthetic) enhances learning", "Students are either left-brained or right-brained, which explains individual differences in learning", or "Students have a predominant intelligence profile, for example logico-mathematical, musical, or interpersonal, which must be considered in teaching. Although widely believed, matching instruction to students' preferred learning styles has been shown to have no reliable effect on learning outcomes (Pashler et al., 2008), confirming that this practice is a neuromyth and should be replaced by evidence-based teaching strategies.

These misunderstandings have served as the basis for developing popular educational programs that claim to be "brain-based" but lack scientific validation (Macdonald et al., 2017; Tokuhama-Espinosa, 2018). These programs appear often attractive to teachers who face increasingly diverse classrooms while feeling unprepared to manage such heterogeneity (Doudin & Meylan, 2022). Thus, classifying students based on their learning style, type of intelligence, or hemispheric dominance and offering them adapted learning methods might offer them a sense of control (Doudin & Meylan, 2022), even if these approaches have not been demonstrated to improve learning outcomes (Waterhouse, 2023; Clinton-Lisell & Litzinger, 2024).

From a pedagogical standpoint, the adoption of neuromyths can lead teachers to make instructional choices that are not only ineffective but also potentially harmful (Blanchette Sarrasin & Masson, 2017). These beliefs may encourage the use of unvalidated practices that limit students' exposure to diverse learning experiences, reinforce fixed mindsets, and confine them to reductive or even stigmatizing categories. While not all neuromyth-inspired programs result in direct harm (Khramova et al., 2023), their widespread use can undermine educational quality and equity.

Moreover, reliance on such strategies may negatively affect teachers themselves. When the expected outcomes are not achieved, teachers—especially those early in their careers—may experience a decline in their sense of professional efficacy (Dekker et al., 2012; Howard-Jones & Fenton, 2012). This disillusionment can contribute to professional burnout and disengagement. Finally, time and resources invested in these unsupported approaches represent a missed opportunity to implement evidence-based pedagogical methods that are demonstrably more effective in supporting student learning (Chojak et al., 2021; Papadatou-Pastou et al., 2021a).

Initial Teacher Education (ITE) has been shown to play a critical role in shaping pre-service teachers' understanding of effective teaching practices and the risks associated with educational neuromyths. Importantly, research has also shown that teacher educators themselves may adhere to certain neuromyths, thereby inadvertently reinforcing and perpetuating these misconceptions among their trainees (Tardif et al., 2015).Several studies highlighted that completing neuroscience courses (Düvel et al., 2017; Macdonald et al., 2017) can act as protective factors for reducing neuromyths, along with reading peer-reviewed scientific journals (MacDonald et al., 2017), having a broader educational background (Zhang et al., 2019), or general knowledge of the brain (Papadatou-Pastou et al., 2017). However, other research indicates that mere exposure to a neuroscience course during ITE does not necessarily diminish such misconceptions (Im et al., 2017; Grospietsch & Mayer, 2018). Overall, it seems that individuals with more advanced neuroscience knowledge are less likely to believe in neuromyths (Howard-Jones et al., 2009; Macdonald et al., 2017). Therefore, integrating neuroscience training into ITE could enhance pre-service teachers' understanding of brain function and the endorsement of evidence-based teaching strategies (Dekker et al., 2012; Dekker & Jolles, 2015 ; Duroisin & Clerc, 2025).

Yet, despite the crucial role of ITE in shaping teachers' understanding of neuroscience, research findings on neuromyth endorsement among pre- and in-service teachers remain inconsistent. This raises questions about the influence of professional experience on teachers' susceptibility to neuromyths. Papadatou-Pastou et al. (2017) found that pre-service teachers sometimes show higher neuromyth belief rates than in-service teachers. Conversely, Dekker et al. (2012) found that teachers with general knowledge about the brain were actually more susceptible to neuromyths, suggesting that the amount of knowledge can be problematic. Furthermore, Macdonald et al. (2017) add that teaching experience does not necessarily correlate with decreased neuromyth endorsement, as misconceptions can persist across career stages. Moreover, authors such as Ferrero et al. (2016) and Hennes, Schabmann, and Schmidt (2024 discovered that both pre- and in-service teachers showed similar levels of endorsement of popular neuromyths such as learning styles or hemispheric dominance, with stronger convictions in the latter group.

Taken together, these findings highlight the need not only to revise ITE program s but also to develop continuous professional trainings for in-service teachers. This requires a thorough understanding of pre- and in-service teachers' beliefs about brain functioning to design programs that effectively address and counteract neuromyths. This study aims to contribute to the growing body of research on neuromyths in education by examining how first-year pre-service teachers and experienced in-service teachers evaluate scenarios involving common neuromyths and evidence-based teaching practices. By comparing their responses, we aim to identify potential knowledge gaps between novice and experienced teachers, particularly regarding teaching strategies supported by cognitive and educational research. Understanding these differences is crucial for refining teacher training programs and developing targeted interventions to address persistent misconceptions from the outset of initial training and throughout professional practice.

Study 1 : Pre-service teachers' Endorsement of Neuromyths

1. Aim of the study

The objective of this first study was to establish an overview of pre-service teachers' endorsement of neuromyths at the beginning of their ITE. In line with previous studies (e.g., (Khramova et al., 2023; Simmers & Davidesco, 2024), we hypothesize that participants will show a significant adherence to well-known neuromyths. This can be explained by their limited neuroscience literacy (Dekker et al., 2012) and their exposure to popular media sources (Sazaka et al., 2024).

2. General procedure

The online survey was distributed in October 2023 for the first cohort and in November 2024 for the second cohort of students. For both cohorts, the questionnaire was completed during the first session of the "Cognitive Psychology and Neuroeducation" course within three higher education institutions from the "Go Prof" consortium, located in the Wallonia-Brussels Federation (Belgium). Therefore, at the time of completing this survey, participants had been officially enrolled in their training for about a month and had not yet received any specific course on neuromyths.

3. Participants

658 students (481 women, mean age = 19.89, standard deviation (SD) = 4.25) enrolled in their first year of initial training participated in this data collection. Within this sample, 176 students aim to teach children aged 3 to 6/7 years old, 260 students aim to teach children aged 5/6 to 7/8 years old, and 222 students aim to teach children aged 10/11 to 13/14 years old. The majority of participants (N=629) held a higher secondary education diploma. Among the remainder, 23 were reorienting after obtaining a short-cycle higher education degree (a three-year bachelor's

program), and 6 had already completed a long-cycle higher education degree (a five-year program combining a bachelor's and a master's degree). Before taking part in the survey, each participant read an information letter and signed an informed consent form.

4. Material

Participants were asked to review five scenarios illustrating a specific pedagogical situation. For example: "*Julie notices that her students have difficulty structuring and memorizing the key points of a text during a lesson. She therefore decides to intervene by implementing a specific teaching practice*." (Translated from French). Unlike the widely used Dekker-style neuromyth questionnaires, which focus on the endorsement of isolated statements, our practice-centered, scenario-based measure situates teaching strategies in authentic classroom contexts. This design provides a more ecologically valid assessment of teachers' pedagogical judgments and is consistent with recent advances such as the Neuroscience against Neuromyth Questionnaire (NNQ; Tovazzi et al., 2020).

Each scenario was presented in two possibilities: one illustrating a teaching strategy influenced by a neuromyth (e.g., the Learning Styles). The other possibility illustrated an effective teaching strategy (e.g., Modeling and Guided Practice). In our study, the scenarios were opposed in the following way and presented to all students in this specific order (Table 1):

	Teaching Strategies Influenced by Neuromyths	Effective Teaching Strategies
Situation 1	Learning styles	Modeling and guided practice (Hattie, 2008; Rosenshine, 2012)
Situation 2	Brain gym	Metacognition (Zimmerman, 2002 ; Karlen et al., 2023)
Situation 3	Multiple intelligences	Differentiation (Tomlinson, 2014 ; Gheyssens et al., 2023)
Situation 4	Brain training	Distributed learning (Cepeda et al., 2006 ; Rohrer, & Taylor, 2006)
Situation 5	Hemispheric dominance	Socio-cognitive conflict (Schnaubert et al., 2021)

Table 1 – Teaching Strategies Influenced by Neuromyths and Effective Teaching Strategies used in the five scenarios

The pairing of each neuromyth and its corresponding evidence-based practice was decided in consultation with all co-authors, based on pedagogical experience. For each of these scenarios, students were asked to express their opinion on the possible effectiveness of the adopted practice in improving the targeted students' academic learning. Thus, on a Likert scale ranging from 1 ('Not at all') to 5 ('Completely'), participants had to answer the question: 'In your opinion, how effective will this practice be in improving students' results?'. Each scenario was presented in French. The order of presentation of scenarios withing each situation was randomized so that participants did not always evaluate the neuromyth-based scenario first. The full set of scenarios, including both neuromyth-based and evidence-based strategies, is available in the Supplementary Materials.

5. Data analyses

For each scenario, participants' responses were aggregated to form a dichotomous variable. A score of 0 was assigned when participants responded with 1 "Totally Disagree" or 2 "Mostly Disagree" on the provided Likert scale. A score of 1 was assigned when participants responded with 4 "Mostly Agree" or 5 "Totally Agree" on the provided Likert scale. Responses scored as 3 were excluded from the analysis, as they reflect a neutral stance and do not contribute to the evaluation of agreement or disagreement. Then, the odds ratios (OR) were calculated for each situation to assess the general degree of agreement regarding the pedagogical effectiveness of the situation among participants. They were calculated using the following formula:

$$OR = \frac{(Number\ of\ responses\ scored\ 4\ or\ 5)}{(Number\ of\ responses\ scored\ 1\ or\ 2)}$$

Each odds ratio obtained was then compared to a hypothetical neutrality threshold (value of 1). Thus, an OR greater than 1 indicates an overall tendency to agree with the situation, while an OR less than 1 indicates an overall tendency to disagree.

Following the guidelines proposed by Chen, Cohen, and Chen (2010), an OR of 1.5 is considered a small effect, 2.5 a medium effect, and 4.3 a large effect. The significance of each OR was assessed using the 95% confidence interval and the Wald test to determine whether the OR is significantly different from 1 (Chen et al., 2010).

To assess the significant differences between participants' responses for situations influenced by a neuromyth compared to situations based on effective teaching strategies, Wilcoxon signed-rank tests were conducted. Comparisons were made by analyzing the responses for each pair of situations (as depicted in Table 1). The significance threshold was set at 0.05 for all analyses.

6. Results of study 1

The analyses of the responses obtained for the 5 practices influenced by a neuromyth are summarized in the table below, including means, standard deviations, OR, confidence intervals (CI), Wald statistics, and significance levels (Table 2).

	Mean	SD	OR	95% CI	Wald	p value	Interpretation
Learning styles	3.83	0.84	8.71	1.38 – 2.49	164.07	<.001	Large effect
Brain gym	2.79	1.19	0.71	-0.56 – -0.12	9.56	.002	Small effect
Multiple intelligences	3.81	1.01	5.06	1.5 – 1.89	140.5	<.001	Large effect
Brain training	3.87	0.94	7.19	1.66 – 2.28	157.29	<.001	Large effect
Hemispheric dominance	3.45	0.97	3.23	0.90 – 1.44	73.41	<.001	Medium effect

Table 2 – Participants' responses Analyses for Neuromyth-inspired Teaching practices

The odds ratio analyses revealed that three neuromyths – Learning Styles, Brain Training, and Multiple intelligences – exhibited large effect sizes, indicating strong endorsement among participants. In contrast, the Brain Gym neuromyth showed only a small effect size, with a significant number of respondents expressing disagreement or neutrality toward this approach. Hemispheric Dominance showed a moderate effect, suggesting partial adherence to this neuromyth, though with less conviction than the others.

The analyses of the responses obtained for the 5 practices illustrating effective teaching strategies are summarized in the table below, including means, SD, OR, confidence intervals (CI), Wald statistics, and significance levels (Table 3).

	Mean	SD	OR	95% CI	Wald	p value	Interpretation
Modeling and guided practice	3.59	0.99	4.84	1.29 – 1.86	117.55	<.001	Large effect
Metacognition	3.02	1.01	1.36	0.08 – 0.53	7.46	.006	Small effect
Differentiation	3.80	1.02	6.03	1.51– 2.08	146.99	<.001	Large effect
Distributed learning	3.79	1.10	5.56	1.43 – 1.99	142.26	<.001	Large effect
Socio-cognitive conflict	3.01	1.19	1.13	-0.08 – 0.33	1.31	.253	No effect

Table 3 - Participants' responses Analyses for Effective Teaching Strategies

The findings showed that Modeling and Guided Practice, Differentiation and Distributed Learning were associated with large effect sizes, reflecting strong endorsement among participants. In contrast, Metacognition showed a small effect size, suggesting a more cautious or moderate perception of its effectiveness. Finally, Socio-Cognitive Conflict did not show a significant effect, with many participants remaining neutral or expressing doubts about its efficacy.

The results revealed that Modeling and guided practice was perceived by participants as significantly more effective than the Learning Styles neuromyth [$Z = 4.79$, $p < .001$], while Metacognition outperformed the Brain Gym approach [$Z = -3.37$, $p < .001$]. Additionally, Socio-Cognitive conflict was significantly favored over the neuromyth of Hemispheric Dominance [$Z = 6.80$, $p < .001$]. No significant differences were found between the Multiple intelligences neuromyth and Differentiation strategies [$Z = 0.38$, $p = .691$], as well as between the Brain training neuromyth and Distributed learning [$Z = 1.34$, $p = .162$].

	Teaching Strategies Influenced by Neuromyths	Effective Teaching Strategies	Wilcoxon signed-ranked statistic	p value
Pair 1	Learning styles	Modeling and guided practice	4.79	<.001
Pair 2	Brain gym	Metacognition	-3.37	<.001
Pair 3	Multiple intelligences	Differentiation	0.38	.691
Pair 4	Brain training	Distributed learning	1.34	.162
Pair 5	Hemispheric dominance	Socio-cognitive conflict	6.80	<.001

Table 4 – Comparative Analyses of Neuromyths and Effective Teaching Strategies: Results from Wilcoxon Signed-ranked Tests

Study 2 : Comparing Neuromyth Beliefs in Pre- and In-Service Teachers

1. Aim of the study

The objective of this second study was to compare the extent to which pre- and in-service teachers adhere to the most well-known neuromyths. Specifically, we examined how both groups perceive pedagogical practices influenced by neuromyths versus evidence-based teaching strategies in terms of their effectiveness in improving student learning. In line with previous findings (e.g., Dekker et al., 2012; Macdonald et al., 2017), we expect similar endorsement of neuromyths between pre- and in-service teachers. However, as noted by Ferrero et al. (2016), we also anticipate that in-service teachers will hold more deeply rooted beliefs compared to pre-service teachers, given their longer exposure to these ideas in professional settings.

2. General procedure

The survey was distributed to pre-service in the first cohort following the methodology described above in Study 1. In-service teachers were contacted through social media and direct connections with the administrations of primary and secondary schools in the Wallonia-Brussels Federation (Belgium). The data collection took place from January to March 2024.

3. Participants

Pre-service Teachers consisted of 384 students (271 women, mean age = 19.79; SD = 3.79) enrolled in their first year of initial training. Most participants (N = 367) held a higher secondary education diploma. However, 17 were in the process of reorienting after obtaining a higher education degree. Among them, 14 had previously obtained a short-cycle higher education degree, while 3 had already completed a long-cycle higher education degree. In-service Teachers included 95 in-service teachers (82 women, mean age = 42.58, SD=10.65), with an average of 17.8 years (SD = 10.40) of teaching experience, with a range from 1 to 41 years. Within this group, 62 held a short-cycle higher education degree, while 33 had obtained a long-cycle education degree. Before taking part in the survey, each participant read an information letter and signed an informed consent form.

4. Material

The online survey used for the second study is identical to that employed in Study 1.

5. Data analyses

To assess the significant differences between groups' ratings of each teaching scenario, Mann-Whitney analyses have been applied. The significance threshold was set at 0.5 for all analyses. Spearman correlation analyses have been applied to explore the relationship between the perceived effectiveness ratings of each scenario and socio-demographic variables such as degree level, teaching experience, gender, and the age section in which the participants teach or intend to teach.

6. Results of study 2

Table 5 presents a summary of the mean scores (with SD), Mann-Whitney U statistics (W), p-values, and rank-biserial correlations for teaching strategies influenced by neuromyths as evaluated by pre- and in-service teachers.

Teachin Strategies	**Pre-service Teachers (N=384) Mean (SD)**	**In-service Teachers (N=95) Mean (SD)**	**W**	**p value**	**Rank-biserial correlation**
Learning styles	3.94 (0.81)	3.35 (1.26)	22881.5	**< .001**	0.24 (small to medium)
Brain gym	2.89 (1.17)	2.36 (1.18)	23020	**< .001**	0.24 (medium)
Multiple intelligences	3.87 (0.94)	3.10 (1.22)	24955	**< .001**	0.35 (medium)
Brain training	3.84 (0.97)	3.64 (0.98)	20669	0.051	0.12 (small)

Hemispheric dominance	3.41 (0.95)	3.57 (1.05)	16369.5	0.075	-0.11 (negligible)

Table 5: Comparative analyses between Pre- and In-service Teachers for teaching stategies influenced by neuromyths : Results of Mann-Whitney U Tests

Mann-Whitney analyses revealed that pre-service teachers rated Learning Styles [M = 3.945 ; SD = 0.808] significantly higher than in-service teachers [M = 3.354, SD = 1.265 ; p<.001]. The rank-biserial correlation of 0.24 suggests a small to moderate effect size, meaning that pre-service teachers view this strategy as more effective than in-service teachers. For the Brain Gym, pre-service teachers [M = 2.891 ; SD = 1.171 1] again rated its efficacy higher than In-service teachers [M = 2.365 ; SD = 1.189 ; p<.001]. The rank-biserial correlation of 0.24 reinforces the idea of a small to moderate effect size, suggesting that pre-service teachers perceive this strategy as more effective than in-service teachers. The Multiple intelligences strategy was rated higher by pre-service teachers [M = 3.875; SD = 0.942] than by in-service teachers [M = 3.104, SD = 1.227 ; p<.001]. The rank-biserial correlation of 0.35 indicates a moderate effect size, suggesting that the pre-service teachers perceive this strategy as particularly effective compared to in-service teachers.

The scoring difference between pre-service teachers [M=3.84 ; SD=0.97] and in-service teachers [M=3.64 ; SD=0.98 ; p=.051] for the Brain training neuromyth is marginal. The rank-biserial correlation of 0.121 suggests a small effect size, indicating that the perceptions of pre- and in-service teachers are relatively similar, although there is a tendency for pre-service teachers to evaluate it more favorably. Finally, regarding Hemispheric Dominance, pre-service teachers [M = 3.417, SD = 0.952] and in-service teachers [M = 3.573, SD = 1.054] showed no significant difference [p = .075], with a rank-biserial correlation of -0.11 that indicates a very weak association, suggesting that both groups evaluate this strategy similarly.

Table 6 presents a summary of the mean scores (with SD), Mann-Whitney U statistics (W), p-values, and rank-biserial correlations for effective teaching strategies as evaluated by pre-service and in-service teachers.

Teaching Strategies	**Pre-service Teachers (N=384) Mean (SD)**	**In-service Teachers (N=95) Mean (SD)**	**W**	**p value**	**Rank-biserial correlation**
Modeling and guided practice	3.53 (1.01)	4 (0.71)	13467	< **.001**	-0.26 (small to moderate)
Metacognition	3.05 (1.09)	3.59 (1.09)	13395	< **.001**	-0.27 (small to moderate)
Differentiation	3.74 (0.99)	4.28 (0.84)	12642	< **.001**	-0.31 (small to moderate)
Distributed learning	3.83 (1.06)	3.89 (1.09)	17664	0.510	-0.04 (small)
Socio-cognitive conflict	3.12 (1.18)	2.72 (1.24)	21630	0.007	0.17 (small)

Table 6: Comparative analyses between Pre- and In-service Teachers for effective teaching strategies : Results of Mann-Whitney U Tests

Mann-Whitney analyses revealed that pre-service teachers rated Modeling and guided practice [M = 3.53; SD = 1.01] significantly lower than in-service teachers [M = 4; SD = 0.71; p < .001]. The rank-biserial correlation of -0.26 indicates a small to moderate effect size, suggesting that in-service teachers view this strategy as more effective than pre-service teachers. For Metacognition, pre-service teachers [M = 3.05; SD = 1.08] again rated its efficacy lower than in-service teachers [M = 3.59; SD = 1.09; p < .001]. The rank-biserial correlation of -0.27 reinforces the idea of a small to moderate effect size, indicating that teachers perceive this strategy as more effective than students. The Differentiation strategy was rated lower by pre-service teachers [M = 3.74; SD = 0.99] than by in-service teachers [M = 4.28; SD = 0.84; p < .001]. The rank-biserial correlation of -0.31 indicates a moderate effect size, suggesting that teachers perceive this strategy as particularly effective compared to students.

The scoring difference between pre-service teachers [M = 3.833; SD = 1.064] and in-service teachers [M = 3.896; SD = 1.090; p = .510] for Distributed learning is not significant. The rank-biserial correlation of -0.04 suggests a very small effect size, indicating that the perceptions of pre- and in-service teachers regarding this strategy are quite similar. Finally, regarding Socio-cognitive conflict, pre-service teachers [M = 3.12; SD = 1.18] and in-service teachers [M = 2.72; SD = 1.24] showed a significant difference [p = .007], with a rank-biserial correlation of 0.17 indicating a small positive effect size, suggesting that students evaluate this strategy more favorably than teachers.

Table 7 presents results of correlational analyses conducted to examine the relationships between educational background (degree level), teaching experience and the ratings of teaching strategies influenced by neuromyths.

	Learning Styles	Brain Gym	Multiple intelligences	Brain training	Hemispheric dominance
Degree level	**-0.16****	**-0.15****	**-0.23****	**-0.11***	**0.09***
Teaching experience	**-0.16****	**-0.17****	**-0.25****	-0.08	0.08
Section	**-0.12***	**-0.15****	**-0.10***	-0.003	-0.09
Gender	-0.05	-0.05	-0.05	-0.02	-0.07

*Table 7 - Spearman's Correlations Between Diploma, Teaching experience and evaluation of teaching strategies influenced by neuromyths (** for p-values <.05 ; and ** for p-values <.001)*

Spearman's correlation analysis revealed significant associations between participants' degree level and teaching experience with perceptions of effectiveness of teaching strategies influenced by neuromyths. Indeed, results showed that degree level correlated negatively with all five strategies, with the strongest association observed for Multiple intelligences (ρ = -0.23 ; p < .001), suggesting that more highly educated individuals tend to rate this strategy less favorably. Similarly, teaching experience negatively correlated with all strategies, with the largest effect for Multiple intelligences (ρ = -0.25 ; p < .001), indicating that participants with more experience tend to rate this strategy as less effective. However, the correlations were small to moderate in magnitude, suggesting that while higher education and experience are linked to more critical evaluations of these strategies, other factors likely contribute to these perceptions. The Section variable showed small but significant negative correlations with adherence to the Learning Styles (ρ = -0.12 ; *p* < .05), Brain Gym (ρ = -0.15 ; *p* < .01), and Multiple intelligences (ρ = -0.10 ; *p* < .05) neuromyths, indicating that students from certain sections were slightly less likely to endorse these neuromyths. Finally, the correlation effect was weak, and no significant correlation was found for Brain Training (ρ = -0.003; *p* > .05) or Hemispheric Dominance (ρ = -0.09 ; *p* > .05).

Table 8 depicts results of correlational analyses conducted to examine the relationships between educational background (degree level), teaching experience and the ratings of Effective teaching strategies.

Variables	**Modeling and guided practice**	**Metacognition**	**Differentiation**	**Distributed learning**	**Socio-cognitive conflict**
Degree level	**0.17****	**0.19****	**0.20****	**-0.02**	**-0.13****
Teaching experience	**0.19****	**0.19****	**0.23****	**0.03**	**-0.12****
Section	**0.12***	0.05	**0.11***	0.01	-0.09
Gender	**-0.13***	**-0.09***	**-0.11***	-0.07	-0.01

*Table 8 - Spearman's Correlations Between Diploma, Teaching experience and evaluation of Effective teaching strategies (** for p-values <.05 ; and ** for p-values <.001)*

As shown in Table 8, there are significant positive correlations between degree level and the teaching strategies of Modeling and Guided Practice (ρ = 0.17; p < .001), Metacognition (ρ = 0.19; p < .001), and Differentiation (ρ = 0.20; p < .001). These results suggest that higher education levels are associated with a more favorable view of these strategies. Conversely, a slight negative correlation with Socio-Cognitive Conflict (ρ = -0.13; p < .001) indicates that more educated individuals may perceive this strategy less favorably, while there is no significant relationship with Distributed Learning (ρ = -0.02; p > .05).

Teaching experience also shows significant positive correlations with Modeling and Guided Practice (ρ = 0.19; p < .001), Metacognition (ρ = 0.19; p < .001), and Differentiation (ρ = 0.23; p < .001), indicating that more experienced teachers tend to view these strategies as more effective. However, the correlation with Distributed Learning (ρ = 0.03; p > .05) is not significant, and there is a slight negative correlation with Socio-Cognitive Conflict (ρ = -0.12; p < .001), suggesting that experienced teachers may also be somewhat skeptical about the effectiveness of this approach.

Spearman's correlation analyses revealed a significant positive correlation between Section and the perception of Modeling and Guided Practice effectiveness (ρ = 0.13; p = .007), indicating that participants' perceptions of this strategy vary across sections. Additionally, the Differentiation strategy also showed a significant positive correlation with Section (ρ = 0.11; p = .020), suggesting that perceptions regarding the effectiveness of the Differentiation strategy also differ among sections.
The correlation analyses revealed a significant negative correlation between gender and several dimensions, indicating that female participants tend to provide lower ratings for Modeling and Guided Practice (ρ = -0.13; p < .05), Metacognition (ρ = -0.09; p < .05), and Differentiation (ρ = -0.11; p < .05).

Discussion

This study contributes to the growing body of research on neuromyths in education (e.g., Ferrero et al., 2016; Grospietsch & Lins, 2021a; Tual et al., 2024) by comparing how first-year pre-service teachers and in-service teachers evaluate scenarios depicting either common neuromyths or evidence-based teaching practices. This study aims to shed light on potential gaps in knowledge and perception between novice and experienced teachers, particularly regarding the effectiveness of teaching strategies supported by cognitive and educational research. Furthermore, given the widespread endorsement of neuromyths among both groups reported in the literature (e.g., Blanchette Sarrasin et al., 2019; Dekker et al., 2012; Simmers & Davidesco, 2024), understanding how these misconceptions persist is crucial for improving pre- and in-service teacher training programs.

Our first study revealed that first-year pre-service teachers showed significant adherence to several prominent neuromyths, particularly those related to learning styles, multiple intelligences, and brain training. This finding is consistent with a substantial body of international research documenting widespread belief in these neuromyths among educators (Dekker et al., 2012; Howard-Jones et al., 2009; Papadatou-Pastou et al., 2017). Recent studies have confirmed that this pattern continues among contemporary pre-service teachers, where poor neuroliteracy limits their ability to distinguish scientific evidence from neuromyths, potentially leading to the implementation of pseudoscientific educational methods (Vig et al., 2023).

Interestingly, participants in our study reported lower adherence to the Brain Gym neuromyth than expected based on prior international literature (Dekker et al., 2012). This observation aligns with the argument that the prevalence of specific neuromyths varies across cultural and linguistic contexts, influenced by local educational traditions and modes of knowledge dissemination (Howard-Jones, 2014). For instance, Dekker et al. (2012) noted that Brain Gym is more frequently encountered in UK schools than in Dutch schools, and its greater presence in English-speaking contexts—where it originated and gained prominence—has been documented by Hyatt (2007) and Spaulding et al. (2010). However, as these studies are now more than a decade old, it is also plausible that belief in Brain Gym has declined over time, which may further account for the lower prevalence observed in our sample. Encouragingly, participants also demonstrated adherence to several evidence-based teaching strategies, such as modeling, guided practice, differentiation, and distributed learning. Participants were asked to rate the effectiveness of each pedagogical scenario independently. Evidence-based strategies generally received higher effectiveness ratings than neuromyth-based strategies, reflecting participants' recognition of scientifically supported teaching practices.

However, notable exceptions emerged. Participants perceived differentiation as equally effective as the theory of multiple intelligences, and brain training as equally effective as distributed learning. These findings are consistent with research suggesting that even novice teachers may have some capacity to differentiate between valid and invalid educational approaches, though confusion can still arise when superficial similarities mask deeper conceptual differences (e.g., Macdonald et al., 2017; Ferrero et al., 2020). These results underscore the persistent challenges in distinguishing between scientifically grounded and pseudoscientific educational concepts and highlight the need to dispel neuromyths, both to prevent the waste of educational resources and to promote more effective theories and methods (Grospietsch & Lins, 2021; Torrijos-Muelas et al., 2021).

The finding that neuromyth adherence is already present at the beginning of ITE suggests that these misconceptions are not necessarily transmitted through teacher training programs, but may instead precede formal professional education. One explanation for this early presence lies in the influence of cognitive biases—particularly intuitive beliefs and subjective perceptions about learning—which shape individuals' understanding of educational processes. People tend to accept ideas that seem personally logical or consistent with their own experiences, even when such ideas lack scientific validity (Blanchette Sarrasin, Riopel, & Masson, 2019). This tendency contributes to the persistent appeal of neuromyths. Compounding this effect is the phenomenon of neurophilia, or the widespread enthusiasm for brain-related information, which has led to heightened public attention toward neuroscience (Van Herwegen et al., 2022). While this growing interest has the potential to enrich educational practices, it also fosters the uncritical acceptance of so-called "brain-based" claims—particularly when popularized through oversimplified or misinterpreted science communication. As a result, teachers and future teachers may adopt practices that appear neuroscientifically grounded but are in fact based on misconceptions. Moreover, neuromyths spread rapidly and are remarkably resistant to change. Their intuitive appeal, combined with their frequent repetition in teacher education, media, and professional development resources, makes them difficult to evict even when presented with contradictory scientific evidence (Grospietsch & Lins, 2021). These observations underscore the need for further research aimed at developing a nuanced understanding of the specific role played by each contributing factor. Such insight is essential to inform how ITE programs can most effectively address these misconceptions and ultimately limit the propagation of neuromyths in educational settings.

Our second study also examined how pre-service and in-service teachers evaluate the perceived effectiveness of teaching strategies influenced by neuromyths compared to evidence-based practices. Our findings provide valuable insights into the perceptions held by these two groups and highlight important implications for teacher education. Previous research has consistently shown that in-service teachers tend to believe in major neuromyths (e.g., Khramova et al., 2023; Sazaka et al., 2024) and has struggled to identify significant differences in neuromyth endorsement between pre-service teachers and those already in the field (Ferrero et al., 2016; Macdonald et al., 2017). However, recent studies examining pre-service teachers have documented continued high prevalence of neuromyth beliefs, with Vig et al. (2023) finding substantial endorsement of neuromyths among Hungarian pre-service teachers, while research has increasingly suggested that differences between pre-service and in-service teachers may indeed exist. Other recent studies, however, suggests that differences may indeed exist. For example, Hennes et al. (2024) reported that pre-service teachers showed stronger adherence to neuromyths than in-service teachers, highlighting the potential protective role of teaching experience. Our findings are consistent with this more nuanced perspective, as in-service teachers in our study demonstrated lower adherence to neuromyths than pre-service teachers. This suggests that teaching experience may be associated with greater neuroscientific literacy (Macdonald et al., 2017).

However, our findings reveal a more nuanced picture. When comparing the two groups, we found that in-service teachers showed less adherence to principal neuromyths (namely learning styles, multiple intelligences, and brain gym) than pre-service teachers. This suggests that teaching experience may be associated with greater neuroscientific literacy (Macdonald et al., 2017). However, results may also reflect the influence of other variables not strictly controlled in our study, such as engagement in continuous professional development or personal interest in evidence-based practices. Indeed, recent research has focused on interventions designed to dispel neuromyths among in-service teachers (Rousseau, 2024), showing that targeted professional development interventions can effectively reduce belief in neuromyths among in-service teachers.

Interestingly, the opposite pattern emerged when evaluating evidence-based practices. For modeling and guided practice, metacognition, and differentiation, in-service teachers demonstrated stronger belief in their effectiveness compared to pre-service teachers. This suggests that professional experience may contribute to more accurate assessment of evidence-based pedagogical approaches and student achievement gains (Podolsky et al., 2019). This finding also echoes research by Buskist & Groccia (2011) and Hattie (2008), who have documented in other contexts growing awareness of evidence-based teaching methods among experienced educators.

The correlation analyses confirmed these ideas by revealing that as education level increases and participants gain more experience, they become less inclined to believe in neuromyths. Conversely, higher education levels and greater experience were positively associated with stronger belief in the effectiveness of evidence-based practices. This finding supports recent work suggesting that advanced education may provide individuals with better critical thinking skills to evaluate educational content (Howard-Jones et al., 2009; Macdonald et al., 2017; Papadatou-Pastou et al., 2021b). Again, this pattern aligns with the idea that teachers with more advanced training demonstrate greater pedagogical content knowledge and can better distinguish between scientifically validated approaches and pseudoscientific claims (Rousseau, 2021). However, effect sizes in our analyses suggest other variables might also play significant roles in these associations.

Limitations

These findings must be interpreted in light of several limitations. First, the relatively small sample size, particularly for in-service teachers, constrains the generalizability of our results. Despite our efforts, recruiting in-service teachers proved challenging. This difficulty may stem from several factors: many had already been surveyed on similar topics by other research teams, and administrative constraints linked to their workload may have further limited their willingness to participate. Second, as noted by Grospietsch and Lins (2021a), teachers' prior knowledge about brain functioning and exposure to information on neuromyths can strongly influence their beliefs. Since these variables were not controlled in our study, the greater endorsement of evidence-based practices and lower adherence to neuromyths observed among in-service teachers may partly reflect a self-selection bias. Our relatively small sample might have disproportionately included individuals already interested in neuroeducation. Several considerations should also be acknowledged. The strength of our study lies in the use of pedagogical scenarios instead of traditional neuromyth questionnaires, which allows to capture teachers' pedagogical reasoning in a manner closer to actual decision-making. However, caution is warranted when considering our results. Indeed, the specific contrasts between neuromyth-based and evidence-based strategies were determined through consultation within our research team, and alternative pairings might have produced different results. Moreover, even if the items were collaboratively developed to ensure they referred explicitly to neuromyths or evidence-based practices, no formal pilot testing was conducted with pre-service or in-service teachers, even though such a step would have been valuable. Another limitation relates to the measurement of knowledge and beliefs. Our survey did not include an explicit "I don't know" option. Although the midpoint of the 5-point Likert scale was treated as a neutral response, our analyses focused only on clear agreement or disagreement. This approach captures general tendencies but does not allow us to distinguish between a true lack of knowledge and a genuine absence of belief. Future studies could address this by offering respondents an explicit option to indicate uncertainty. To address these limitations, future studies should rely on larger and more representative samples while also including measures of teachers' prior neuroscientific knowledge and exposure to neuromyth-related information. Longitudinal designs could further illuminate how beliefs evolve with professional experience and development, as suggested by McMahon et al. (2019).

Conclusion

These results have significant implications for both ITE and continuing professional development programs. The finding that in-service teachers demonstrate less adherence to neuromyths suggests that practical experience may contribute to the development of more evidence-informed perspectives. However, the persistence of some neuromyths even among experienced educators indicates that experience alone is insufficient (Ruiz-Martin et al., 2022; Tual et al., 2024). Recent studies by Ferrero et al. (2023) and Grospietsch & Lins (2021b) have demonstrated the effectiveness of targeted interventions that explicitly address neuromyths and provide accurate information about learning and the brain. Our findings reinforce the importance of integrating such approaches into ITE programs. The implications of our results are particularly important considering the negative consequences of neuromyth adherence, including decreased teacher self-efficacy and the waste of resources that could be better allocated to evidence-based strategies (Blanchette Sarrasin et al., 2019; Van Herwegen et al., 2022; Khramova et al., 2023). Additionally, the positive correlation between education degree and assessment of effective teaching strategies suggests that ongoing professional development opportunities should be available throughout teachers' careers. The greater appreciation for evidence-based practices among more experienced teachers highlights the value of creating communities of practice where experienced educators can share their knowledge with pre-service teachers (Rousseau, 2024; Sazaka et al., 2024). Indeed, Menz et al. (2021) showed that pre-service teachers may often rely more on anecdotal than scientific evidence when forming educational beliefs. Communities of practice could therefore help bridge this gap, allowing novice teachers to benefit from the expertise of experienced colleagues, accelerate the development of pedagogical competence, and reduce adherence to neuromyths in educational settings.

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Data availability statement
The material and data that support the findings of this study are openly available on the Open Science Framework (OSF) at the following link: https://osf.io/swrkf/?view_only=2bb322ab08a545a5a6f9dfc3a35a4400

Declaration of generative AI and AI-assisted technologies in the writing process.
During the preparation of this work the author(s) used Claude 3.7 Sonnet to identify language errors (spelling and grammar) and reformulate certain phrases to improve clarity. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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