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Neuroeducational Research

Teaching – It's a No Brainer, Right?: Using an Assessment Course to Bust Educators' Neuromyths

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Abstract

Misinformation about the brain, known as neuromyths, is prevalent among educational practitioners and often inadvertently (mis)informs instructional strategies. In the current study, a mixed methods design was used to test how resources and instruction on neuromyths delivered as part of an assessment course impacted elementary education pre-service teachers' (PSTs') beliefs about the brain. Specifically, this study aims to address: (1) Where do PSTs learn neuromyths? (2) Does an explicit focus on "neuromyth-busting" in a required course shift PSTs' understanding of neuroeducational science? (3) What are PSTs' understanding of neuroeducational science and the impacts on their practice after this course? Results from a pre-/post-survey show that many of the PSTs' neuromyth beliefs shifted by the end of the course. Through open-ended survey responses, PSTs reported that they had learned about neuromyths from a variety of resources and their thoughts about neuromyths are multifaceted and complex. By the end of the course, PSTs related what they learned about the brain to the importance of differentiating instruction. The findings suggest that using a mixed methods approach provides a well-rounded view of PSTs' beliefs about neuromyths. Incorporating information about the brain in education courses may be an effective way of promoting critical thinking and dispelling common neuromyths among PSTs.

Keywords: misinformation, neuromyths, survey, assessment, education

Resum

La desinformació sobre el cervell, coneguda com a neuromites, és prevalent entre els professionals de l'educació i sovint inadvertidament (mal) informa de les estratègies d'instrucció. En l'estudi actual, es va utilitzar un disseny de mètodes mixtos per provar com els recursos i la instrucció sobre neuromites lliurats com a part d'un curs d'avaluació van afectar les creences dels professors pre-servei d'educació primària (PST) sobre el cervell. En concret, aquest estudi té com a objectiu abordar: (1) On aprenen els PST els neuromites? (2) Es fa un enfocament explícit en el "neuromit-busting" en un canvi de curs necessari per a la comprensió de la ciència neuroeducativa? (3) Què entenen els PST de la ciència neuroeducativa i els impactes en la seva pràctica després d'aquest curs? Els resultats d'una pre-/post-survey mostren que moltes de les creences neuromites dels PST van canviar

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al final del curs. A través de respostes d'enquestes obertes, els PST van informar que havien après sobre neuromites a partir d'una varietat de recursos i que els seus pensaments sobre neuromites són polifacètics i complexos. Al final del curs, els PST relacionaven el que van aprendre sobre el cervell amb la importància de diferenciar la instrucció. Els resultats suggereixen que l'ús d'un enfocament de mètodes mixtos proporciona una visió ben completa de les creences dels PST sobre els neuromites. Incorporar informació sobre el cervell en els cursos d'educació pot ser una manera eficaç de promoure el pensament crític i dissipar els neuromites comuns entre els PST.

Paraules clau: desinformació, neuromites, enquesta, avaluació, educació

Introduction

Misconceptions about the brain are widespread throughout the world. These misconceptions, known as neuromyths, germinate when information about the brain is mistranslated, misinterpreted, misquoted, or oversimplified[1,2,3,4,5,6]. For example, it is empirically proven that the brain has two hemispheres, and while certain functions are localised within each hemisphere, they regularly interact and communicate with each other (Ansari, 2008). It is commonly believed, however, that because mathematical reasoning is driven by the left hemisphere, and emotions are driven by the right hemisphere, individuals have a dominant side and can be categorised as either a "mathematical thinker" or "creative thinker"[5,7,8]. Categorising oneself, or others, as left- or right-brained may prevent people from engaging in tasks that require the skills driven by their "non-dominant" hemisphere.

Considering many neuromyths pertain to teaching and learning, many educators are susceptible to believing in them. The neurological mechanisms of learning are not commonly taught in education courses, therefore, many neuromyths are often promulgated in teacher preparation programs (TPPs)[9]. One of the most prominent neuromyths that perpetuates in education is learning styles[10,11] which suggests that each student can be identified as either a visual, auditory, or kinesthetic learner, and that teachers should tailor their instruction to each child's preferred learning style[12,13,14,15]. While students may have learning preferences, empirical evidence suggests that information is not processed more effectively when taught in one's preferred style[16,17]. Although the learning styles myth has been debunked[18,19,20], teachers are still often encouraged to account for student learning styles in lesson plans[6,21,22].

To reduce neuromyths and limit their impact, Ulusoy and colleagues suggest: (1) increasing communication between neuroscientists and educators, (2) informing educators more effectively, (3) training pre-service teachers (PSTs) on neuromyths, (4) designing neuromyth-busting interventions, (5) gaining a better understanding of how neuromyths affect teaching, (6) establishing a guide to detect neuromyths in the literature, and (7) standardising methods for classifying and investigating neuromyths[23]. Few of these strategies have been tested (see, for example, McMahon et al., 2019)[24]. In the current study, we investigated PSTs' understanding of neuromyths before and after an assessment course in their initial teaching certification program that explicitly incorporated instruction on neuromyths. Throughout the course, students engaged in a variety of learning experiences and accessed a range of reference materials to mitigate the impact of PSTs' previously held neuromyths on their current and future educational practice and to increase critical consumption of research. The following research questions guided this study:

1. Where do PSTs learn neuromyths?
2. Does an explicit focus on "neuromyth-busting" in a required course shift PSTs' understanding of neuroeducational science?
3. What are PSTs' understanding of neuroeducational science and the impacts on their practice after this course?

Materials and methods

This study employed a pre-/post-survey, within-group, quasi-experimental design. Student participants were recruited from two sections of the second author's elementary education assessment course to measure the extent to which the course changed their beliefs in specific neuromyths. Using a concurrent triangulation design, qualitative and quantitative data were collected simultaneously, analysed separately, and then integrated for analysis.

Participants

Participants were recruited from the second author's graduate, alternative teacher certification elementary education TPP in a medium-sized, private university classified as having a high level of doctoral research activity (R2). After obtaining approval from the host university's institutional review board, the second author shared the purpose and design of the study with students (*N* = 34), explained that there were no penalties or rewards for participation, and obtained signed informed consent from interested students (100%). The PST program requires this assessment course in the final semester prior to field placement and student teaching experiences.

The participants reflected the typical candidate for alternative initial teacher certification. Approximately 30% of PSTs are prepared through *alternative* route certification providers; two-thirds are located in institutes of higher education and the remaining one-third are served elsewhere (e.g., local education agencies, school districts, regional education service agencies)[25]. Alternative certification programs typically serve PSTs who are allowed to be provisional teachers of record while they earn their credentials and often serve more diverse PSTs than traditional programs. Greater than 80% of participants were already teaching in area elementary schools on provisional teaching certificates, and the gender and racial/ethnic demographics details of the participants reflect the more demographically diverse makeup of alternative TPPs and are shown in **Table 1**.

Materials, Measures, and Procedures

Pre- and post-surveys were designed to measure the extent to which the course shifted PST beliefs about neuromyths and were administered digitally on the first and last days of class during the eight-week semester. After completing the neuromyths pre-survey (adapted and revised from Dekker et al., 2012)[7] via Google Forms (see Supplementary Materials), students were exposed to a variety of instructional materials and learning activities (see **Figure 1**) designed to inform them about neuroeducational scientific findings. These materials included a guest lecture by the first author, videos, course textbook readings, scholarly journal articles, and explicit neuromythologicaly-focused feedback on assignments from the second author. Students were expected to apply what they learned throughout the course, including their understanding of how to apply brain science to assessments and teaching for their portfolio task, a detailed lesson plan that required analyzing student data (e.g., academic, social-emotional, demographic) to develop differentiated learning experiences grounded in educational theory and research-based instructional strategies. Students completed their

Table 1. Participant Demographics

Aggregated Race and Gender	Race and Gender by Course	
Total Sample (*n* =29)	Spring 2022 (*n* = 14)	Summer 2022 (*n* = 15)
Female: 27 (93%) Male: 2 (7%)	Female: 12 (86%) Male: 2 (14%)	Female: 15 (100%) Male: 0
Asian: 2 (7%)	Asian Female: 1 (7%)	Asian Female: 1 (7%)
Black: 20 (69%)	Black Male: 2 (14%)	Black Male: 0
	Black Female: 7 (50%)	Black Female: 11 (73%)
White: 7 (24%)	White Female: 4 (29%)	White Female: 3 (20%)

Note. Only the gender and race/ethnicity categories identified by the participants are included.

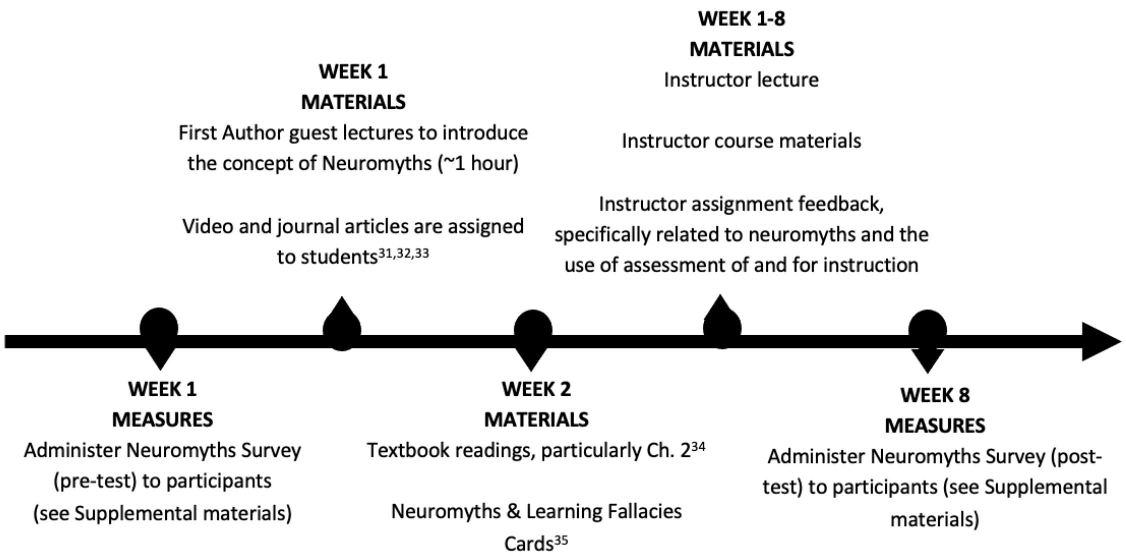

Figure 1. Neuromyths Instruction Embedded in Elementary Education Assessment Course

lesson plans by the last week of the semester and took the post-survey, which was identical to the pre-survey with the addition of a reflection section (see Supplementary materials). While there was an explicit and intentional focus on teaching PSTs about neuromyths and a more accurate understanding of contemporary neuroeducational research to enable application to their lesson plans, the priority course objectives were focused on the assessment of teaching and learning in elementary education.

Analytic Approach

Using a concurrent triangulation design, quantitative data (i.e., selected-response items on the neuromyths surveys) and qualitative data (i.e., open-ended responses on the neuromyths surveys) were analysed separately, compared, and integrated for analysis. The second author analysed the quantitative data using IBM SPSS Statistics (Version 28) to measure the degree and direction of changes in student responses. The first author led the analysis of the qualitative data. A thematic and holistic coding approach was used for the first round of coding, with more specific ideas highlighted in the second round[26]. The second author reviewed and edited the codebook. Both authors discussed their findings to address coding discrepancies and to confirm and refine themes.

Results

Quantitative

Origins of Neuromyths. PSTs were asked to identify the sources of information they used to inform their beliefs about teaching, learning, the brain, and the frequency with which they consulted each. A Wilcoxon signed-rank test was conducted to determine the effect of course instruction on where and how often students sourced data on neuromyths related to teaching and assessment. The order of the assessments was counterbalanced for each information source variable, and the difference scores were approximately symmetrically distributed, as assessed by a histogram with a superimposed normal curve[27]. Cases with missing data, usually post-survey, were eliminated listwise resulting in a total sample size of 29 PSTs. **Table 2** shows the means and standard deviations for each prompt at both survey administrations, the amount of directional shift in responses (e.g., moving up the Likert scale towards 4–Always from 1–Never), and the significance. Of the eight information source options, the only statistically significant post-survey change was that students reported

Table 2. Changes in How Frequently and Where Students Seek Information About Teaching

Information Sources	Pre-Survey		Post-Survey		Directional Response Change			*z*	*p*
	M	SD	M	SD	Lower	No Change	Higher		
Professors/college courses	2.621	.8625	3.000	.8452	4	13	12	2.209	**.027**
Professional learning opportunities	2.621	.7752	2.690	.6603	7	15	7	.460	.646
Social media (Twitter, Facebook, Reddit, etc.)	2.000	.6547	2.241	.7863	5	14	10	1.538	.124
Google Scholar or other academic source	2.172	.7106	2.345	.8975	8	11	10	.832	.405
Friends	2.241	.5766	2.345	.7689	4	16	9	.639	.523
Family	2.172	.7106	2.034	.7784	7	17	5	.966	.334
Wikipedia, Google, etc.	2.379	.9029	2.414	.9456	6	15	8	.166	.868
Other	1.586	.7328	1.621	1.1047	6	17	6	.247	.805

Note. Significance = **Bolded**.

an increase in seeking information from professors and college courses from pre- (Mdn_{Pre} = 2.621) to post-survey (Mdn_{Post} = 3.000), z = 2.209, p = .027. There were no statistically significant changes over time for any of the other variables.

Neuromyth Busting. To answer our second research question, we analysed participants' responses to a series of eleven educational neuromyth true/false prompts at each survey administration, the proportion of change for each response from pre- to post-survey, and the statistical significance, if any. Statistics are the result of an exact McNemar's test[28] based on the binomial distribution (i.e., where there is a total of ≥ 25 total discordant pairs where participants changed their responses) as opposed to those from approximate *p*-values derived by comparison with a chi-squared distribution (with one degree of freedom), a method of continuity correction[29].

There were statistically significant changes ($p \leq .003$) in PSTs' correct responses from the pre- to post-survey for three items: beliefs that instruction should be aligned to students' learning styles, students have strengths associated with their left versus right hemisphere categorization, and that playing classical music makes students smarter (i.e., the Mozart effect; see **Table 3**). Though not significant, PSTs gave more correct answers in the post-survey on five items with the percentage of correct answers increasing from 6.89% (humans only use 10% of their brain) to 24.14% (most students learn better in one type of learning style). However, the percentage of PSTs who answered items correctly in the post-survey decreased for three items: infant-directed speech is beneficial for children's brain development (-10.34%), the brain stops developing in adolescence (-6.9%), and the brain is no longer plastic during adulthood (-6.9%). These results suggest that the course was effective at dispelling some, but not all, neuromyths the PSTs held.

Qualitative

Open-ended, constructed responses to pre- and post-survey questions were analysed to determine where PSTs learned the neuromyths they believed and how their thinking might have changed after they participating in the assessment course.

Origins of Neuromyths Continued. To further address the first research question, PSTs were asked to elaborate on where they learned the information that informed their quantitative survey respons-

Table 3. Proportions of Change from Pre-Survey to Post-Survey

Prompt	Pre-Survey		Post-Survey		Amount of Change		p
	True	False	True	False	False → True	True → False	
Most students learn better in one type of learning style (e.g., visual, auditory, kinesthetic) over another. False	10 (34.48%)	19 (65.52%)	3 (10.34%)	26 (89.66%)	3	10	.092
When a teacher matches their instruction to the learning style of a student, that student will learn more efficiently. False	28 (96.55%)	1 (3.45%)	16 (55.17%)	13 (44.83%)	1	13	**.002**
Some students are more left-brained, meaning they're more logical and mathematical, and some students are more right-brained, meaning they're more creative. False	25 (86.21%)	4 (13.79%)	14 (48.28%)	15 (51.72%)	1	12	**.003**
If you're right-handed, you are left-brain dominant, and if you're left-handed, you are right-brain dominant. False	12 (41.38%)	17 (58.62%)	6 (20.69%)	23 (79.31%)	1	7	.070
Playing classical music to children can increase their intelligence level. False	23 (79.31%)	6 (20.69%)	6 (20.69%)	23 (79.31%)	1	18	**<.001**
Humans only use 10% of their brain. False	16 (55.17%)	13 (44.83%)	14 (48.28%)	15 (51.72%)	5	7	.774
Infant-directed speech is beneficial for children's development. True	22 (75.86%)	7 (24.14%)	19 (65.52%)	10 (34.48%)	2	5	.453
Your brain stops developing during adolescence. False	0 (0%)	29 (100.00%)	2 (6.90%)	27 (93.10%)	2	0	.500
The brain is most plastic during early childhood. True	12 (41.38%)	17 (58.62%)	18 (62.07%)	11 (37.93%)	9	3	.146
The brain is no longer plastic during adulthood. False	3 (10.34%)	26 (89.66%)	5 (17.24%)	24 (82.76%)	2	0	.500
Brain damage is permanent. False	14 (48.28%)	15 (51.72%)	8 (27.59%)	21 (72.41%)	2	9	.065

Note. Correct Neuromyth Response = Shaded. Significance = **Bolded**.

es. PSTs reported acquiring information about the neuromyths from a variety of resources including textbooks, common knowledge, conversations with friends and/or family, the media, and other online sources such as Pinterest. Of the 29 PST responses included in the analysis, 12 students (~41%) reported having been taught neuromyths from previous college courses and/or professors which is consistent with our quantitative findings and previous research. However, 18 (~62%) of the PSTs reported learning about the topics from multiple sources adding nuance to the statistics. For example, one student wrote, "[I first learned the information through] life experiences, media, perceptions, [and] education." Another responded, "Most of my answers came from other resources such as books or information I read or heard about online. I also used my teaching knowledge for some as well." These results suggest that neuromyths are reinforced through a variety of resources both formal (e.g., coursework, professional experiences) and informal (e.g., media) channels.

Neuromythological Impacts on Practice. To address our third research question, we asked the PSTs to reflect on 1) how their answers had changed, if at all, since the pre-survey, 2) the most surprising things they learned about neuromyths and the brain, particularly in relation to learning and assessment, and 3) how those surprises may impact their plans for instruction and assessment (as either a current or future teacher). Twenty-eight PSTs (~97%) completed the post-survey reflection questions.

Changed Responses. When reflecting on the change in their responses from pre- to post-survey, 23 (~79%) of the PSTs indicated that their responses shifted quite a bit after learning about the brain and neuroeducational applications to instruction throughout the course. The results can be roughly broken down into three themes, each with equal numbers of participants in each: "aha" moments, remaining unsure, and improving critical thinking. About a third of the 23 PSTs reported changing their answers due to an "aha" moment after engaging with the neuromyth resources and realising that what they may have heard about the brain in the past may not be true. One PST wrote, "I believe some of my answers changed [from the pre-survey] due to finding out that they were myths." Roughly another third of these PSTs indicated that they now realize that much of what they believed to be true are neuromyths, but that "there's still some stuff [they are] unsure about." The remaining of these 23 PSTs reported an improvement in their critical thinking skills. One wrote, "In my learning, I believe I am more reflective. This necessitates me thinking a little deeper and being a little more introspective in my daily activities." Another said, "I've learned that there is not just one way of learning and/or understanding children." Two PSTs indicated that they now seek out more empirical work and information from professors and colleagues: "I have started to read different scholar[ly] papers, and honestly I've learned a lot." These findings show that there is a wide range in the extent to which PSTs have internalised what they learned about neuromyths and reflected on the resulting implications for their educational views and behaviours, both in terms of their knowledge-seeking and their application toward improving their instructional or assessment practices.

Neuromyth Surprises. Almost all the students indicated that what surprised them most was that what they had previously thought to be true about the brain was incorrect. PSTs seemed to be most surprised by the learning styles myth. One PST wrote, "It was surprising initially to learn that learning styles are essentially useless, especially since some of my graduate classes have reiterated them in teaching." Another said, "...Many teachers are still using these [learning styles] to teach... and I can remember them being taught to me in school." Though almost all PSTs indicated that they now understand that many myths propagate about the brain in education, one student explained how challenging it is to change your mind about something you once believed in: "I think that because learning and education are ever evolving and more information is learned, the beliefs that I hold to be true have been altered, and it's hard to break away from those proposed truths." Overall, most PSTs supported the idea that there is a lot of information about the brain circulating in both formal and informal settings that are either partially or completely untrue.

Impacts on Practice. When asked to reflect on how learning about neuromyths may impact their practice, one main theme emerged: differentiated instruction. Many of the PSTs who responded to this question indicated that they had learnt the importance of recognising that children can learn in multiple different ways and that it is therefore necessary to teach in a variety of methods. One PST wrote, "Overall, just consider the whole child as you plan... If we develop lessons and assessments with this in mind we can truly learn how to differentiate and meet student's needs." Similarly, another PST said, "I like the idea of teaching students in a variety of different ways, and not just the way that they supposedly learn best." Other PSTs wrote about how they learned that "it is worth researching how the brain works" and "to be critical of the information I come across and use balance when taking on ideas."

Discussion

Both the quantitative and qualitative survey responses support two main conclusions: (1) neuromyths are often taught as valid teaching and learning considerations throughout the TPP pipeline, and (2) the belief in learning styles is still a particularly prominent myth that is difficult to let go of. While each analysis pointed to the same takeaways, our understanding is stronger having used this mixed methods approach. For example, the constructed responses of the PST provided additional texture, shading, and detail to interpret both the learning and resultant shifts in practice PSTs may have left this course with, and the statistical evaluation provided us with the degree, directionality, and significance of the changes captured. Together, we are better able to identify which neuromyths appear to be the hardest to dislodge and how the explicit neuromyth focus in this class both supported PSTs' learning and fell short of achieving more sustainable outcomes. To generate a deeper and more sustainable reduction in neuromyth adherence, TPPs may benefit from providing deeper, ongoing, or more reinforced neuroeducational learning experiences throughout an initial teacher certification program of study.

The quantitative survey responses showed that PSTs learned correct information about some neuromyths, but not all, a finding that was further supported by the many PSTs who wrote in their reflections that they still found it difficult to understand—and, one might argue, to believe—some neuroscientific information, especially when it contradicted something they believed to be fundamentally true. It is clear that the PSTs were successful in learning that much of what they had previously believed to be true about the brain is not empirically supported, and PSTs were surprised by a lot of the myths, especially the pervasive myth about teaching for students' learning styles echoing prior published findings[10,11]. Furthermore, after reflection, they were shocked to realize that these myths had been perpetuated by other instructors in courses throughout their TPP. Though the PSTs learned the truth about the neuromyths addressed, their reflections indicate that changing one's mind about deeply rooted ideas is challenging.

Misinformation about the brain and learning continues to plague the field of education. Teachers who believe in neuromyths are likely to use potentially ineffective instructional strategies based on these misconceptions, especially at the preschool and elementary levels[22,30]. Our findings that (1) PSTs learn about neuromyths from a variety of sources including in college courses, (2) our intervention helped PSTs learn the truth about some neuromyths but not all, and (3) by learning about the brain and its relationship to learning, PSTs mainly took away the idea that differentiated instruction is crucial, further exposing the well-known disconnect between neuroeducational research and teaching practice.

Although most of the neuromyths addressed in the survey have been debunked for many years, PSTs reported having learned about many of them in recent TPP college courses. Some PSTs reported that they were taught to consider student "learning styles" during instruction in their own undergraduate and graduate classes. Additionally, many PSTs conveyed that when they were in primary or secondary school, their teachers talked about learning styles as if they were an effective teaching method. One student, anecdotally, was so upset to learn that the learning styles neuromyth had been debunked for some time, that she repeatedly verbalised it in class, and commented on the second author's course evaluation, that she should have been forewarned that such a shocking revelation would be shared in the course. Not only do neuromyths perpetuate throughout the field of education, but they seem to persist for long periods. As Ulusoy and colleagues suggest, these results demonstrate the importance of educating teachers (at all grade levels) about neuromyths[23].

The PSTs showed regression in their responses to some of the neuromyth items (infant-directed speech, adolescent brain development, and adult brain plasticity), which may be because these topics were not covered as consistently or as germane as others in an elementary education assessment course, unlike teaching to students' learning styles and the Mozart effect. Similar to McMahon's and their colleagues' findings, many PSTs in the current study demonstrated critical thinking skills in their post-survey reflections[24]. Not only did the PSTs discuss their thoughts about neuromyths in an analytical manner, but they also frequently mentioned the importance of critical thinking when deciding which instructional methods to employ in their classrooms. Although the students did not score perfectly on the post-test, their awareness of neuromyths and the need to be critical was highlighted in their reflections.

However, this finding was not supported by the PSTs' notes. Out of curiosity, both authors asked for permission to look at the PST's notes from when they engaged with the neuromyth resources. We found that the PSTs commonly copied direct quotes from the resources into their notes with few comments and ideas of their own. Though the PSTs reported the importance of critical thinking, they did not demonstrate critical thinking in their notes. Similarly, PSTs' initial drafts of elements of the key lesson plan assignment for candidates' portfolios showed a similar lack of criticality and were improved upon revision only after the second author provided explicit feedback challenging PSTs to evaluate and justify the planned instructional approaches using evidence from research. PSTs may be more likely to demonstrate critical thought when they know for certain that instructors and researchers will be evaluating their responses, particularly on an assessment, but are less likely to apply these new understandings in novel circumstances they see as unrelated like their class notes or their lesson plan assignments. This finding may shed light on how neuromyths are spread and persist: students take what they hear and read in courses verbatim without always developing their ideas, verifying the source, or making the leap to application. TPP professors should consider explaining, modelling, and valuing (e.g., through grades, instructional practices, and reinforcement) the importance of questioning everything, even when it comes from an authority figure (e.g., faculty) or other reliable source.

In addition to demonstrating critical thinking about neuromyths in the post-survey, PSTs routinely discussed the importance of differentiating instruction. Although teaching to the individual child is an empirically supported teaching strategy, it is interesting that this was the main idea that PSTs retained after the course. After learning about some of the neuromyths addressed in the survey and knowing that the assessment data-driven lesson plan was the major assignment for the course, it is understandable that differentiating instruction was a main theme in the PSTs reflections. For example, after knowing that just because a student prefers to learn in a certain style does not mean they will learn better when taught in that style, or knowing that music does not make you smarter or perform better on tests, it is reasonable to conclude that everyone learns differently and instructors should take that into account when teaching (i.e., differentiate instruction). Given that differentiating instruction is regularly discussed throughout teacher preparatory courses, this may be an easily digestible conclusion to grasp after reviewing complex, unfamiliar neuroscience information. Future research is warranted to determine how exactly PSTs are linking this broad, vague, but beneficial, concept of differentiated instruction to neuromyths and ways TPP professors can better support candidates in questioning and applying neuroeducational data to their practice both broadly across tasks and domains and specifically by being able to articulate the metacognitive processes behind their instructional choices.

Conclusions

This study shows that by routinely and deliberately integrating information about neuromyths into TPP classes, we can help to limit belief in some neuromyths and stimulate critical thinking. By using mixed methods, we can gain a more well-rounded view of what PSTs think about neuromyths and how their thoughts change over time which can, in turn, shift our practices to better prepare teacher candidates. However, there is still much more to learn to bridge the gap between the neuroscience and teaching.

Limitations

This study is not without its limitations. A larger sample size would provide more power for our pre- and post-survey results; it is plausible that with a larger sample, we could avoid potential Type II errors giving us even more actionable results. The data in this study was collected over a full, albeit condensed, semester, however, revisiting the PSTs after the course concluded would allow us to understand the persistence of any effects we may find by addressing neuromyths recursively throughout a course or TPP. Determining whether PSTs use critical approaches to reject neuromyths or seek accurate neuroeducational data to guide their practice would be particularly beneficial to gauge the longitudinal impact of the course or TPP. It is also important to note that teachers at all levels must adhere to curriculum guides, pacing guides, and other district or university policies. It may be challenging to fully integrate neuromyths into all TPP methods or foundational courses, especially when doing so necessitates eliminating other equally important content. Future research is warranted to further investigate methods of integrating neuromyths into curricula.

Ethical statement

This work was conducted in accordance with the 2018 Federal Regulations 21 CFR 56.110(b) and 45 CFR 46.110(b) for expedited review and was approved under category 7 per 63 FR 60364 by the Institutional Review Board at the second author's institution (IRB #H2201007).

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Access to materials

Materials are available upon request.

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Supplementary materials

Survey administered to PSTs before and after the intervention

What is your name?*

Your answer

Please indicate which of these statements you believe to be true and which you believe to be false.*

	True	False
Most students learn better in one type of learning style (e.g., visual, auditory, kinesthetic) over another).	◯	◯
When a teacher matches their instruction to the learning style of a student, that student will learn more efficiently.	◯	◯
Some students are more left-brained, meaning they're more logical and mathematical, whereas some students are more right-brained, meaning they're more creative.	◯	◯
If you're right handed, you are left-brain dominant, and if you're left-handed, you are right-brain dominant.	◯	◯
Playing classical music to children can increase their intelligence level.	◯	◯
Humans only use 10% of their brain.	◯	◯
Infant-directed speech is beneficial for children's development.	◯	◯
Your brain stops developing during adolescence.	◯	◯
The brain is most plastic during early childhood.	◯	◯
The brain is no longer plastic during adulthood.	◯	◯
Brain damage is permanent.	◯	◯

How confident do you feel about your responses today?*

- ◯ Very Confident
- ◯ Somewhat Confident
- ◯ Neutral
- ◯ Not at all Confident

How often do you seek out information about teaching and learning from the sources below?*

	Never	Sometimes	Often	Always
Professors/college courses	◯	◯	◯	◯
Professional learning opportunities	◯	◯	◯	◯
Social media (Twitter, Facebook, Reddit, etc.)	◯	◯	◯	◯
Google Scholar or other academic source	◯	◯	◯	◯
Friends	◯	◯	◯	◯
Family	◯	◯	◯	◯
Wikipedia or Google	◯	◯	◯	◯
Other	◯	◯	◯	◯

If you selected "Other" above, please briefly describe the source here.
Your answer

Briefly describe how or where you learned the information that informed your answers above.
Your answer

The following are only included on the post-test:
Please reflect on how your responses have changed (if they did) since the pre-test.*
Your answer

What were some of the most surprising things you learned about neuroeducational considerations, particularly as they relate to learning and assessment?*
Your answer

How do those surprising things you learned impact your most as you plan for instruction and assessment in your (current or future) classroom)?*
Your answer