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Debunking Neuromyth in Education: What is the Fact and What is Fiction for Malaysia Teachers?

MUHAMMAD SYAWAL AMRAN & WERNER SOMMERABSTRACT

Research in Neuroscience and Education aims to bridge the gap between education, neuroscience and cognition. However, numerous challenges continue to hinder the integration between education and neuroscience, such as neuromyth in education. The main aim of this study was to verify whether Malaysian teacher is susceptible to misconceptions about neuroscientific findings that impair their teaching. An online survey was conducted among (n = 501) school teachers, covering 14 neuro facts and four neuro fiction about the brain. Results show 82.2% of participants believe the differences between the left brain and right brain can help explain individual differences amongst learners, and 89.2% of participants believe that 'Individuals learn better when they receive Information in their preferred learning style (e.g., auditory, visual, kinesthetics). For the neuro facts, 83.6% of teachers correctly classified 'There are sensitive periods in childhood when it's easier to learn things', and 79.2 % responded correctly to 'Information is stored in the brain in a network of cells distributed throughout the brain. Our findings show the importance of improved interdisciplinary communication to prevent such misconceptions and foster effective collaboration between neuroscience and education in the future.

Keywords: Neuromyth, Fact, Fiction, Teachers, Classroom

INTRODUCTION

The role of brain science in education has seen significant growth in recent years, especially within the fields of neuroscience and cognitive psychology. Technological advances, such as neuroimaging, have enabled neuroscience research to offer intriguing insights into the brain's characteristics, structure, and functions. Even though these findings are often complex and challenging, they may help to improve teachers' pedagogical practices (OECD, 2002). However, building a connection between neuroscience and education is complex, as educators often believe that neuroscience findings can be directly applied in classrooms (Goswami, 2006). In other words, the concern arises when limited knowledge about the brain leads to the emergence of neuromyths (Ansari et al., 2012; Howard-Jones, 2014), that is, "misconception's] generated by a misunderstanding, a misreading, or a misquoting of facts scientifically established (by brain research) to make a case for the use of brain research in education and other contexts" (OECD, 2002, p. 69).

Surveys conducted in the USA, UK, Germany, the Netherlands, Greece, and Turkey reveal that over 50% of teachers believe in and implement brain myths in their classrooms (Dekker et al., 2012; Gleichgerrcht et al., 2015; Canbulat et al., 2017; Macdonald et al., 2017; Grospietsch et al., 2021). These studies also highlight that numerous individuals and companies take advantage of these neuromyths for commercial gain, promoting products and methods that claim to enhance educational practices. These activities shape teachers' beliefs in neuroscientific claims that lack sufficient empirical support. For instance, many teachers hold the belief that male students' brains are inherently better suited for learning mathematics compared to female students, or that students who predominantly use their left cerebral hemisphere are more creative than those who use the right (Allen & Van der Zwan, 2019; Corballis, 2014). Such notions are often not or not sufficiently fact-based and, hence, pseudoscientific. Thus, Dekker et al. (2012) and Howard-Jones (2014) pointed out that both cerebral hemispheres are needed to process information well and, in turn, produce critical and creative thinking. In normally developed adults, the use of only one hemisphere cannot support proper brain function.

The inclusion of neuroscientific context in education encourages lay people to believe that neuroscientific explanations are per se more sound than psychological explanations and contribute to the spread of neuromyths among teachers (Weale, 2017; Lethaby & Harries, 2016; Brenda Hughes et al, 2021). Moreover, many publications, conferences, and educational materials prepared by non-specialists facilitate the proliferation of neuroscientific content to educators (Goswami, 2006; Grospietsch & Mayer, 2019). These issues lead to commercial exploitation

by commercial enterprises, promoting or selling educational products or brain training programs. Interestingly, non-specialists from programs that may use neuroscientific terminology or claims to market products, despite a lack of scientific evidence supporting their effectiveness. Consequently, it can mislead particular educational communities and motivate purchasing the product without delivering the promised result.

In Malaysia, the prevalence of courses, workshops and educational talk programs related to brain-based learning has increased strongly in recent years (Fadhlina Zabide, 2018; Alee Song et al., 2021). For instance, assessment using the Visual, Auditory and Kinesthetics (VAK) test is often associated with the student's brain. VAK aims to identify the student's preferred learning style (sensory modality) and supposedly allows them to choose the style most suitable for them (Norshidah Saleh., et al, 2022). Also, there are claims that by training students using this method enables them to recall memories more easily and quickly by efficiently transferring information between the hemisphere, leading to a fuller development of the brain and maximizing learning potential. (Fadhlina Zabide, 2018; Alee Song et al., 2021). However, empirical tests of the effectiveness of matching teaching methods with individual learning styles are inconclusive. In fact, a comprehensive review of the scientific literature conducted by a group of psychologists and neuroscientists known as the Learning Styles Group (Torrijos-Muelas, et al., 2021) concluded that there is no convincing evidence supporting VAK as a basis for designing teaching instruction. This shows that teachers may misunderstand how their students learn and how the brain works.

Similar and ill-founded ideas are also proliferated by adherents of "Neurolinguistic Programming" (NLP). The term NLP consists of three parts: "neuro," which is the neurological system, "linguistics," which is the message, both verbal as well as non-verbal, that is sent to the brain; and "programming," which is how the mind processes these messages (Annisa Wahyuni, 2019; Gaffar, 2021). NLP gives teachers the impression of understanding how the brain learns and allows them to adapt their teaching to suit students' learning preferences (Sabariah Sharif et al., 2015: Aminah Hanisah et al., 2022). Due to these claims, NLP programs are attractive tools to support pedagogy and practice. However, the scientific status of NLP is controversial because most of its concepts are linked to assumptions about the brain and are poorly supported by evidence (Witkowski, 2010; Sturt et al., 2012; Passmore et al., 2019). Specifically, Witkowski (2010) and Passmore et al. (2019) suggest that research with brain-related NLP yet needs to adhere to the most basic protocols in research, such as explicit inclusion/exclusion criteria and search strings, multiple databases and independent validation.

There needs to be evidence about the prevalence of misconceptions about the brain and their application by teachers in Malaysia. However, there are concerns about the proliferation of neuromyths, particularly among the teachers' community. The application of incorrect beliefs and misconceptions about the brain may lead to a significant loss in money, energy and time and, in the worst case, may even be damaging to the students (Dekker et al., 2012; Macdonald et al., 2017; Gleichgerrcht et al., 2015; Canbulat et al., 2017; Ferrero et al., 2016; Gardner, 2020; Grospietsch et al., 2021). Therefore, the present study aims to determine the knowledge and belief in neuromyth about the brain in Malaysian classrooms. By investigating the relationship between neuromyths and their application and the contribution of factors such as the teacher's educational level, teaching experience and gender, we seek to uncover nuanced insights into the impact of neuromyths in education. This research should be given serious attention because false beliefs about the brain will negatively affect teaching, training, curriculum and research in education.

MATERIAL AND METHODS

PARTICIPANTS

Registered teachers and teaching professionals throughout Malaysia participated in the present study. They were recruited nationally via social media networks (Facebook and Telegram) in the registered national teacher online group at various time points across a 12-months period. These teachers had no background or formal training/ certificate from any institutions related to neuroscience. Table 1 presents the demographic and professional characteristics of the final sample. It consisted of 402 women (80.2%) and 99 men (19.8%); most participants were experienced teachers; 50.3% had more than 10 years of teaching experience and only 30.7 % had less than three years. Teachers worked at pre-schools (n = 42; 8.2%), primary schools (n = 232; 54.5%) and secondary schools (n = 228; 45.5%). The majority of the teachers had an academic background (Bachelor's Degree in Education: n = 370; 73.9% , Master's Degree: n = 74; 14.8%, or Diploma: n = 57, 11.4%). Being interested in scientific knowledge about the brain and its influence on learning was stated by 98% of the participants. Furthermore, 95% believed that this knowledge is very valuable for their teaching practice.

Table 1 Demographic and Professional Characteristics of the final Sample.

Demographics		N	Percentage (%)
Gender	Male	99	19.8
	Female	402	80.2
Age (Years)	< 30	173	34.5
	31-40	130	25.9
	41-50	96	19.2
	> 50	102	20.4
Educational Level	Diploma	57	11.4
	Bachelor	370	73.9
	Master	74	14.8
Schools	Pre-Schools	41	8.2
	Primary Schools	232	54.5
	High Schools	228	45.5
Teaching experience	< 3 years	154	30.7
	4 - 10 years	95	19.0
	> 11 years	252	50.3

MATERIALS AND PROCEDURE

The online survey was inspired by similar questionnaires by the Organisation for Economic Co-operation and Development (OECD, 2002), Howards-Jones et al. (2009), Dekker et al. (2012), and Tardif et al. (2015). There were three section in this survey 1) Demographics such as gender, academic background and others. 2) Belief in four mayor neuromyth in education, consisting in general assertions about the brain, e.g., "The left and right hemispheres of the brain always work together". 3) Literacy about 16 Neuro facts, consisting in 16 statement consider into three scale "True", 'Not fact' and 'do not know". These surveys were translated into Malay language and piloted among researchers and teachers for clarity and validity. Average completion time for the whole questionnaire was 10 minutes. The reliability analysis of the test, Cronbach's Alpha reliability coefficient of the test was calculated as 0.78. The study was approved by the Faculty of Education Research Ethics Committee of the University Kebangsaan Malaysia (GGPM-2021-22) A consent to participate in this research was obtained from the participants. Participation in this study is entirely voluntary.

The presentation order of myths and knowledge assertions was randomized. Answer options were "incorrect", "correct", or "do not know". Dependent variables were the percentage of incorrect answers on neuromyth assertions (where a higher percentage reflects more frequent beliefs in myths) and the percentage of correct responses on general assertions, where a higher percentage reflects more literacy about neuro facts and the percentage of correct responses on general assertion.

DATA ANALYSIS

The participants' answers were quantified and statistically processed. No missing data were recorded at participant or item level. The data was analysed using the Statistical Package for the Social Science (SPSS) version 22.0 for Windows. To identify the level of neuromyth beliefs in education and actual brain facts, basic statistical analyses were conducted (calculus of means and standard deviations). In order to make descriptive comparison between different neuromyth beliefs in education scale and brain facts, these means were considered by the number and percentages of items in each statement. To find the prevalence of neuromyth belief in education, the percentages were computed by combining level 4 (somewhat agree) and 5 (strongly agree).

RESULTS AND DISCUSSION

NEUROMYTHS

Table 2 shows the frequency of correct, incorrect and do not know answers to each of the 4 neuromyths in education. In details, about 138 (27.7%) participants also do not know 'the incorrectness of the statement *'We only use 10% of our brain'* and 412 (82.2%) participants belief '*Differences*

in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners. Moreover, 446 (89.2%) participants believe that *'Individuals learn better when they receive information in their preferred learning style (e.g., auditory, visual, kinesthetics).* The findings also elucidate that 357 (71.3%) participants endorsed 'correct' for the statement *"Short bouts of co-ordination exercises can improve integration of left and right hemispheric brain function".*

Table 2. Belief in Neuromyths in Education

No.	Claim	Correct (%)	Incorrect (%)	Do not know (%)
1	We only use 10% of our brain.	32.5	39.7	27.7
2	Differences in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners.	82.2	6.4	11.4
3	Individuals learn better when they receive information in their preferred learning style (e.g., auditory, visual, kinesthetics).	89.2	6.2	4.6
4	Short bouts of co-ordination exercises can improve integration of left and right hemispheric brain function.	71.3	7.6	21.2

NEURO FACTS

Table 4 shows the frequency of correct, incorrect and do-not-know answers to each of the 16 neuroscientific statements. The results show that 62.1% (Mean; 3.10) of the teachers were able to correctly classify facts and fiction about the brain, reflecting their brain literacy. Specifically, about 374 (74.7%) teachers incorrectly answered the statement '*When we sleep, the brain shuts down,* and 364 (72.7%) incorrectly answered '*Mental capacity is hereditary and cannot be changed by the environment or experience'.* Also, 236 (47.7%) don't know the correctness of the statement *'Circadian rhythms ("body-clock") shift during adolescence, causing pupils to be tired during the first lessons of the school day".* Moreover, 419 (83.6%) teachers correctly classified '*There are sensitive periods in childhood when it's easier to learn things'* and 398 (79.2 %) responded correctly to '*Information is stored in the brain in a network of cells distributed throughout the brain.* Interestingly, the findings reflecting knowledge about the brain particularly in education may contribute to the knowledge about misconceptions among teachers and help counteract their perpetuation of neuromyth. Knowledge concerning the brain functions particularly in education is important in order for teachers to understand the neural mechanism that support learning processes.

Table 4 Literacy about Neuro Facts

No	Claim	Correct (%)	Incorrect (%)	Do not know (%)
1	*We use our brains 24 hours a day (F)*	74.7	19.4	6.0
2	Boys have bigger brains than girls (F)	32.1	38.5	29.13
3	When a brain region is damaged other parts of the brain can take up its function (F)	24.8	52.7	22.6
4	The left and right hemisphere of the brain always work together (F)	75.6	8.2	16.2
5	Information is stored in the brain in a network of cells distributed throughout the brain (F)	79.2	4.0	16.8
6	Learning is not due to the addition of new cells to the brain (F)	53.1	24.8	22.2
7	Learning occurs through modification of the brains' neural connections (F)	66.3	6.4	27.3
8	Academic achievement can be affected by skipping breakfast (F)	70.7	19.4	10.0
9	Normal development of the human brain involves the birth and death of brain cells (F)	57.5	13.8	28.7
10	Vigorous exercise can improve mental function (F)	57.9	25.3	16.8

continue ...

... cont.

11	Circadian rhythms ("body-clock") shift during adolescence, causing pupils to be tired during the first lessons of the school day (F)	40.3	12.0	47.7
12	Production of new connections in the brain can continue into old age (F)	60.5	16.6	22.9
13	There are sensitive periods in childhood when it's easier to learn things (F)	83.6	3.0	13.4
14	*When we sleep, the brain shuts down (NF)*	18.4	74.7	6.9
15	*Brain development is complete by the time children reach secondary school (NF)*	15.4	70.9	13.8
16	*Mental capacity is hereditary and cannot be changed by the environment or experience (F)*	13.8	72.7	13.6

Note: *(F) Fact; (NF) Not Fact

CONCLUSIONS AND PERSPECTIVES

This study examined general knowledge about the brain and neuromyth beliefs among teachers in Malaysia. The results indicate that overall, teachers belief in neuromyth are prevalent among teacher in Malaysia and are consistent with those found in previous research in other countries, indicating generally strong misconceptions of neuroscience and moderate gaps in general knowledge about the brain, learning and behaviour. Moreover, current findings confirm the prevalence of neuromyths applied in teaching practice. These results validate previously voiced concerns about the proliferation of neuromyth in the field of education (OECD, 2002; Goswami, 2006). These findings reflect that teachers who are enthusiastic about the possible application of neuroscience findings in the classroom are not well able to distinguish pseudoscience from scientifically validated facts; that is, they frequently lack basic knowledge about Biopsychology, Neuroscience, Education and Psychology. These results also provide significant findings to limit the misconception and misapplication of brain-based ideas in educational practices in the classroom (Donoghue et al., 2016)

The present results demonstrate the need for enhanced interdisciplinary communication to reduce such misunderstandings and misconceptions in the future and create successful collaboration between neuroscientist and educators. We found even though the distance between neuroscience and education is still too far. Experts who specialize in the field of neuroscience, psychology and education together should translate scientific literature and findings into easy-to-understand language for teachers. In teacher education curriculum training, there is a need to integrate knowledge related to the mind, brain and education to further improve skills in designing teaching and learning approaches in the classroom.

Future studies suggest an in-depth interview with teachers who adhere to neuromyth practices in the classroom. Even studies also need to get expert views on how these brain-based ideas can be translated into educational contexts and help in avoiding the widespread application of neuromyth in the classroom. Although, the integration of brain-based ideas in educational practice remains challenging, joint efforts of scientists and practitioner may pave the way towards a successful collaboration between these fields.

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