

TOWARDS A PARADIGM SHIFT WITH NEURO-ENTREPRENEURSHIP EDUCATION: A LESSON FOR THE DEVELOPING ASIAN NATIONS

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ABSTRACT

The field of neuro-entrepreneurship explores the specific characteristics that drive entrepreneurs' decisions and contribute to their success. Recent advancements in neuroscience offer a new way to understand how entrepreneurs think and behave. This understanding has led to a shift in entrepreneurial education, with a focus on integrating neuroscientific techniques. However, research in neuro-entrepreneurship is still fragmented, and there is a lack of comprehensive literature reviews. We are presenting a thorough review to address this gap and emphasize the urgent need for developing countries in South and South East Asia to incorporate neuroscientific techniques into entrepreneurial education, starting from the school level. The current entrepreneurial education in Sri Lanka suppresses the innovation and creativity of aspiring entrepreneurs, leading to a high demand for traditional practices. Integrating neuroscientific techniques into entrepreneurial education at all levels can help foster successful and productive entrepreneurs. This also emphasizes how experiments and neuroscientific techniques can improve entrepreneurial theories. This calls for a significant change in entrepreneurship education, aiming to cultivate a comprehensive entrepreneurial mindset in developing Asian nations.

KEYWORDS: *Cognitive Neuroscience, Entrepreneurial Behavior & Mindset, Neuro-entrepreneurship Education, PRISMA*

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1. INTRODUCTION

Entrepreneurship is widely seen as a driver of economic growth. However, in developing countries, there is uncertainty about whether entrepreneurship education effectively equips individuals to independently implement viable business ideas alongside theoretical knowledge (Hanuun et al., 2023). Recent research has explored the use of neuroscientific techniques to study entrepreneurial skills, mindsets, and behaviors (Massaro et al., 2023). The Institute of Growth Concept (2016) suggests that incorporating neuroscientific techniques into entrepreneurial education at all levels can help cultivate successful entrepreneurs.

Neuroentrepreneurship is a new research field in which many developed countries invest human capital to study emerging mental health challenges and their crucial role in policy implementation (Sharma et al., 2021). The study of entrepreneurship is a complex science influenced by various perspectives and intervening factors. The psychology of entrepreneurship utilizes cognitive and behavioral sciences to examine entrepreneurial behavior (Pidduck et al., 2023). The field of cognitive science explores heuristic ideas and the entrepreneurial mindset to identify cognitive processes that enable quicker and more efficient decision-making (Gilbert-Saad et al., 2023). An individual with an entrepreneurial mindset can create value by recognizing and seizing opportunities, making decisions with incomplete information, and maintaining flexibility and resilience in complex and challenging circumstances (Joshua et al., 2021).

Recently, there has been a significant increase in efforts to understand the factors contributing to entrepreneurial success. This is evident through a rise in academic research, publications, and a thriving business consultancy sector catering to entrepreneurs (Elkaim, 2020; Lesonsky, 2019). While studies recognize that a Management Mindset and an Entrepreneurial Mindset complement each other, they also emphasize that transitioning from one to the other can lead to a sustainable competitive advantage (Wright et al., 2000). Behavioural analysis places a

strong emphasis on how entrepreneurs make decisions regarding their competence and behaviour. Entrepreneurial behaviour is influenced by traits such as dynamism, leadership, risk-taking ability, adaptability, and internal drive (Pidduck et al., 2023).

The different types of entrepreneurial opportunities such as creative, exploratory, allocative, and imitation are supported by specific attributes (Chrysikou, 2014; Hunter, 2013; Sarasvathy et al., 2010). When examining entrepreneurship, organizational characteristics like innovation, development, and expansion are also taken into consideration (Cucino et al., 2021). Further, there are factors that prevent individuals from becoming entrepreneurs; cognitive bias can affect an individual's risk assessment and decision-making, causing them to view entrepreneurship as too risky (Thomas, 2018). Neurological differences can impact traits like risk tolerance, creativity, and resilience, which are vital for entrepreneurship (Massaro et al., 2023). Furthermore, the current education system in Sri Lanka suppresses the innovation and creativity of undergraduates, leading to a high demand for government jobs or brain drain (Fernando, 2019).

2. EVOLUTION OF THE CONCEPT

The emerging field of neuro-entrepreneurship education combines cognitive neuroscience and entrepreneurial education (Korpysa, 2020). Researchers use tools such as Electroencephalogram (EEG), Functional Magnetic Resonance Imaging (fMRI), eye tracking, and Galvanic Skin Response to investigate the neural underpinnings of entrepreneurial decision-making. In their work, Korpysa (2020) introduces the concept of neuro-entrepreneurship and argues for the application of neuroscience in studying entrepreneurial processes.

A pictorial summary of the evolution of neuro-entrepreneurship is created using techniques from cognitive neuroscience, along with sub-branches of entrepreneurial education and cognitive and behavioral science. Figure 1 illustrates the interdisciplinary approach to entrepreneurship.

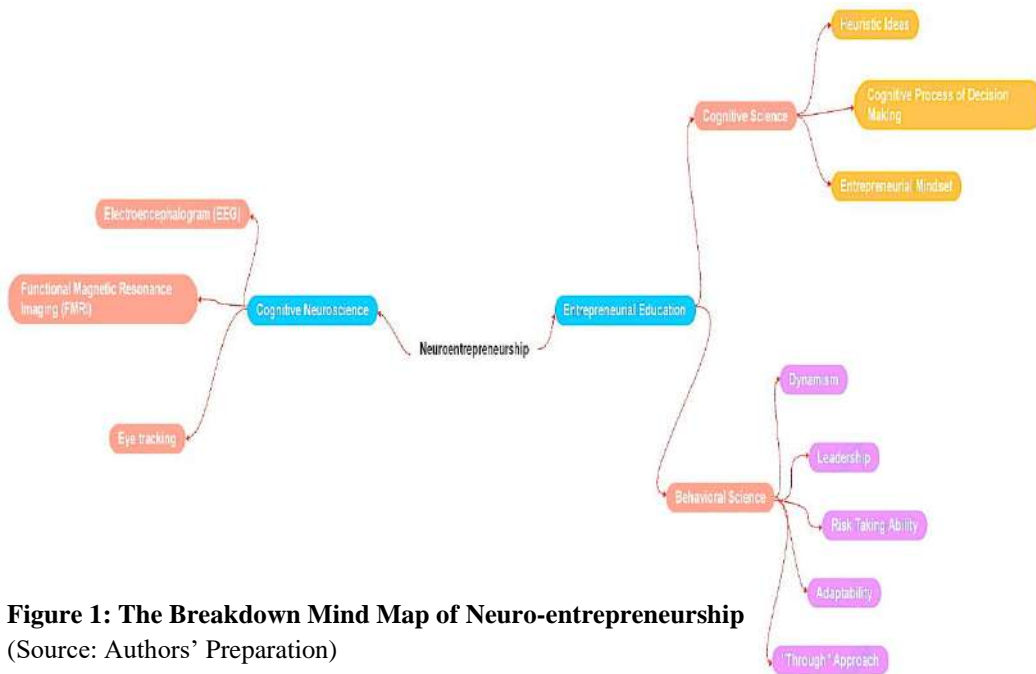


Figure 1: The Breakdown Mind Map of Neuro-entrepreneurship
(Source: Authors' Preparation)

The study by Zaro et al. (2016) utilized cognitive brain mapping (CBM), a quantitative research tool, along with EEG readings. EEG recordings were taken while fourteen male participants, including both experienced business owners and non-entrepreneurs, made decisions. The study analyzed the flow of information across different brain areas using entropy correlation calculations, providing insights into the cognitive processes associated with entrepreneurship. The small sample size was justified, highlighting the potential for significant findings in neuroscience research through consistent brain activation patterns at the individual participant level.

The use of cerebral mapping allowed for the analysis of network structures related to entrepreneurial decision-making, creating Cognitive Brain Maps through the computation of entropy values.

The Massaro et al. (2023) uses fMRI to measure the traits of entrepreneurs through various experimental designs. The "pure insertion" assumption is used to compare brain activity in response to different tasks through cognitive subtraction. Additionally, cognitive conjunction evaluates common brain regions between different cognitive process stages. The parametric design treats the variable of interest as continuous and examines correlations between

changes in the variable and alterations in brain activity.

Functional integration models show promise for understanding social cognition, leadership dynamics, and entrepreneurship by examining different brain regions while they are interacting during activities and while they are at rest.

In a study conducted by Kaminskiene et al. (2023), an eye-tracking method was used to research entrepreneurship education. After reviewing 505 papers, 105 were found to be relevant. Eye-tracking systems, from lab to mobile, measured pupil size, fixations, and saccades to gain insights into learning processes and attention distribution in both controlled and uncontrolled environments. By considering the perspectives of teachers and students, this approach enhances established qualitative and quantitative methodologies in entrepreneurship education research.

3. ‘THROUGH’ APPROACH TO ENTREPRENEURIAL EDUCATION

The study's research problem addresses the lack of investigation and integration of neuroscientific

methods as a comprehensive approach in the context of entrepreneurship education in Asian countries (Ghina et al., 2017). Although the traditional view of entrepreneurship has historically placed more emphasis on behavioral and psychological aspects, recent advancements in neuroscience offer a novel way to comprehend the thoughts and actions of entrepreneurs. The study highlights a theoretical and practical gap in the development of a new paradigm for entrepreneurial education due to the insufficient use of neuroscientific methodologies in entrepreneurship education in developing Asian nations.

According to Cucino et al. (2021), Asian nations are lagging behind in integrating neuroscientific methods into entrepreneurial education. Specifically, the application of neuroscience in entrepreneurship remains a subject of debate in Sri Lanka (Jauk & Kanske, 2021). Empirical studies by Cucino et al. (2021), Jauk & Kanske (2021), and Jeyaseelan et al. (2023) have revealed the significant lack of neuroscientific education, especially in entrepreneurship, in developing Asian countries.

The majority of current instructional strategies are based on conventional wisdom, which overlooks the potential benefits offered by neuroscientific understandings for better understanding and fostering an entrepreneurial attitude and behavior. The lack of research in this field creates a significant knowledge gap, making it challenging to fully grasp how neuroscientific methods could be utilized in local entrepreneurship education (Cucino et al., 2021; Jauk & Kanske, 2021).

The study indicates that there is a significant gap in Asian entrepreneurship education regarding the use of neuroscientific techniques and experimental methodologies. The absence of experimental applications, such as transcranial magnetic stimulations (TMS) and control tasks like the BART risk-taking game, hinders the exploration of brain and psychological behaviors essential for a complete understanding of neuro-entrepreneurship. The research emphasizes the necessity for a shift in the paradigm of entrepreneurship education systems in Asian countries. To foster a comprehensive

entrepreneurial mindset, the traditional "about" or "for" approaches should be replaced by a more dynamic and practical "through" approach that integrates neuroscientific strategies at the educational level.

The research issue that has been identified has significant implications for academics and policymakers in Asian nations. Addressing the gap in the theoretical and practical applications of neuroscientific tools in entrepreneurship education can lead to the development of a more efficient and comprehensive paradigm. This shift is crucial for fostering entrepreneurial skills, mentality, and behavior that align with the evolving business and innovation landscape of the twenty-first century.

4. RESEARCH OBJECTIVES

This study seeks to connect theory with practice by creating a new framework that utilizes insights from neuroscience to improve the comprehension and development of entrepreneurial attitudes and behaviors. We propose a model for incorporating neuroscientific methods into entrepreneurship education in developing Asian countries, with a focus on addressing specific gaps.

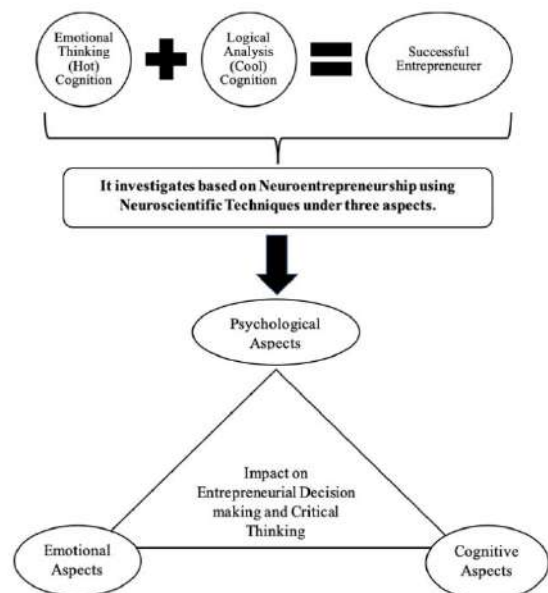


Figure 2: Visualizing the transformation of the entrepreneurship into neuro-entrepreneurship (Source: Authors' preparation)

The study aims to provide insights into the implications of addressing the theoretical and practical gaps in neuro-entrepreneurship education for academia and policymakers. It emphasizes the potential benefits of a paradigm shift to foster entrepreneurial skills, mentality, and behavior that align with the evolving business and innovation landscape. The study also seeks to contribute to the advancement of neuro-entrepreneurship education by offering practical recommendations and a holistic framework that addresses the identified gaps and supports the development of more effective and relevant educational paradigms in the context of developing Asian nations.

The literature on neuro-entrepreneurship examines the differences in brain activity between entrepreneurs and non-entrepreneurs using various neuroscientific techniques. According to Lawrence et al. (2008), successful entrepreneurs engage in both emotional (hot) thinking and logical analysis (cool). Frontal lobes regulate neural activity, which occurs in multiple parts of the brain. Stanton et al. (2008) used neuroeconomics methods to investigate the rationality of entrepreneurs' decisions. Zald et al. (2008) found that entrepreneurs, similar to risk-takers, have increased dopamine receptor density in their brains. Heydari et al. (2020) describes entrepreneurial cognition as the cognitive structures that influence assessments, judgments, and decisions in opportunity evaluation and venture formation. They draw on the literature on social cognition and cognitive psychology to understand the mental processes behind entrepreneurial activity.

Heydari et al. (2020) also suggests three important elements for the growth of the field of neuro-entrepreneurship: rejecting the computational theory of the brain, emphasizing outcomes like mirror neurons, empathy, semantic simulation, dopamine system, and habits, and replacing the conventional Turing machine with new tools.

The study by Heydari et al. (2020) delves into the mental processes involved in entrepreneurial learning, exploring aspects such as purpose, convictions, and complex knowledge systems. It highlights the importance of technical skills, interdisciplinary collaboration, and an understanding of perceptions, causes, and effects. According to

Heydari et al. (2020), the study introduces a model that encompasses temporal, neurological, and cognitive dimensions, suggesting that examining cognitive processes at various levels is crucial for comprehending entrepreneurial behavior.

Simon (1997) is recognized as the first to analyze three levels of cognition-related phenomena: the external level, which focuses on observable behavior; the internal level, which delves into attitudes, beliefs, and intentions; and the deep level, which examines neurological processes (Heydari et al., 2020). Recent years have seen a significant increase in global entrepreneurship research across diverse fields, acknowledging the vital role of entrepreneurship in the economic and social development of nations (Shane, 2000; Davidsson, 2016).

The impact of entrepreneurship extends beyond market innovation and economic growth to encompass job creation, contributing to higher employment levels (Shane, 2000). As the focus on entrepreneurship education and the cultivation of an entrepreneurial mindset through schooling continues to grow, entrepreneurship education has been steadily advancing (Kuratko, 2005). To gain better insights into the factors influencing entrepreneurial behavior, researchers have conducted studies across various industries and regions using survey analysis, experiments, and interviews (Fayolle et al., 2016; Mustafa et al., 2016; Al-Jubari et al., 2016).

5. PAPER RETRIEVAL

Turulja et al. (2020) conducted research on entrepreneurial ambitions and informal support, demonstrating that family and friends have a significant beneficial influence on entrepreneurial goals. However, it is important to critically assess the methodological limitations of their study, such as sample size and cultural context. Similarly, Wegner et al. (2019) utilized the theory of entrepreneurial promotion to show a strong correlation between entrepreneurial education and intent. Nevertheless, the study could benefit from a more in-depth exploration of how different types of educational interventions impact entrepreneurial outcomes. The studies by Lopes et al. (2020) and Rasool et al. (2021) emphasize the influence of environmental factors on entrepreneurial inclinations. However, it is crucial to

consider the socio-economic and infrastructural disparities between urban and rural areas that might contribute to these differences.

After reviewing research publications, it was found that there is an intrinsic relationship between neurology and entrepreneurship, which makes neuro-entrepreneurship a new and unexplored field of study. Research has looked at the practical implications of neuro-entrepreneurship in management and entrepreneurship, despite the challenges in expressing its theoretical and practical contributions (Cucino et al., 2021). This study provides a comprehensive guide for business owners and researchers interested in neuro-entrepreneurship research and emphasizes the importance of discussing the common approaches and trends in this field of study. The research uses bibliometric techniques, such as VOS viewer, to visualize the results of the literature analysis and understand research patterns in literature knowledge networks (Van Eck and Waltman, 2010).

The brain is essential to the human experience as it controls our thoughts, emotions, and actions, shaping our perception of the world (Seung, 2012). Despite its crucial role, our understanding of the brain's complex functions has historically been limited, especially in the field of entrepreneurship study (Alivisatos et al., 2013). Scholars interested in entrepreneurship are intrigued by the inner workings of the mind, but their comprehension of mental processes is hindered by insufficient tools. Rather than delving into the reasons and mechanisms behind entrepreneurial thinking, the focus is often on the traits and behaviors of entrepreneurs (Mitchell et al., 2002; Shane, 2000; Mitchell et al., 2005; Haynie et al., 2010).

The working definition of a nascent entrepreneur is an individual who is undertaking efforts to start a new venture alone or with the support of others. Entrepreneurial mindset refers to a creative cognitive ability to derive entrepreneurial behaviors and innovative applications. There has been a proliferation of educational courses and practical workshops that are focused on teaching the required skills and information for creating and executing new company ideas. This is a direct outcome of the notion of "Entrepreneurship" gaining major importance in

the discourse of global business as well as the local context of the business.

Fayolle and Kuckertz (2013) argue that there is an ongoing debate about the content, objectives, and methods of entrepreneurship education, despite the increasing availability of such courses. Research shows contradictory outcomes regarding the impact of entrepreneurship education. Some studies suggest that there is no clear positive impact on the entrepreneurial intentions of undergraduate students (Graevenitz et al., 2010; Oosterbeek et al., 2010). According to Bennett (2006) and Mwasalwiba (2010), existing studies do not provide enough evidence to conclusively determine how current training methods affect the development of new entrepreneurs. There is also insufficient research to support active teaching methods, such as case studies, group discussions, and business simulations (Bennett, 2006; Mwasalwiba, 2010). Overall, there is a lack of consensus on the key factors influencing the entrepreneurial intentions of undergraduate students.

The plan for nascent entrepreneurship includes a recognized redesigned teaching technique based on existing research. According to Mwasalwiba (2010), traditional teaching approaches in higher education are limited by high costs, time-consuming nature, and divergence from ordinary university teaching practices. Osterwalder and Pigneur (2010) and Ries (2011) have presented innovative approaches to encourage the growth of prospective company owners, such as using a business model canvas combined with the lean start-up movement. Despite the potential of the Design Thinking (DT) method, there is currently a lack of evidence that it successfully fosters an entrepreneurial mindset among students (Daniel, 2016).

The focus of this research is to further review the ongoing discussion on the potential for entrepreneurship stemming from educational backgrounds. It aims to examine the contribution of factors such as entrepreneurial motivation, entrepreneurial self-efficacy, and personal difficulties on the formation of a nascent entrepreneurial mindset. As noted by Fayolle et al. (2006), the nascent entrepreneurial mindset is a critical factor in realistic entrepreneurial behavior,

representing the perspective and readiness for engaging in entrepreneurial activities. Within this realistic entrepreneurial behavior, the main influencing factor is the self-efficacy of potential entrepreneurs, which utilizes their intention and confidence levels (Fayolle et al., 2006). According to Daniel (2016), investigations of potential entrepreneurship are motivated by dynamic factors such as self-efficacy and exciting challenges against the crucial entrepreneurial mindset. Although Sri Lanka lags behind in implementing neuroscience into entrepreneurship, a few institutions, like the Institute of Growth Concept, have revolutionized Neuro-Energized Training (NET) techniques at the core of their methodology, resulting in an 80 percent impact on successful business startups (Institute of Growth Concept, 2016).

6. HETEREDOX PERSPECTIVE ON ENTREPRENEURSHIP

As noted by Smith et al. (2019), the intersection of entrepreneurship and region has become an increasingly important topic in the academic study of cultural aspects and communities worldwide. The authors conclude that social systems have a significant impact on entrepreneurship globally, influencing the beliefs, values, and traditions of people in various ways. Pidduck and Tucker (2022) found that mindful heterodoxy can emerge from the intersection of religious beliefs and business approaches within society's sub-systems, leading many entrepreneurs to exhibit behaviors and characteristics associated with heterodoxy. Given the complexity of the relationship between religion and business, further research in this area is necessary. Entrepreneurship also involves identifying future market trends and related products and services, requiring risk-taking. These risk-takers come from diverse religious backgrounds. Smith et al. (2021) highlight the need for examining the correlation between religion and entrepreneurial mindset, as well as the effects of religion on enterprises.

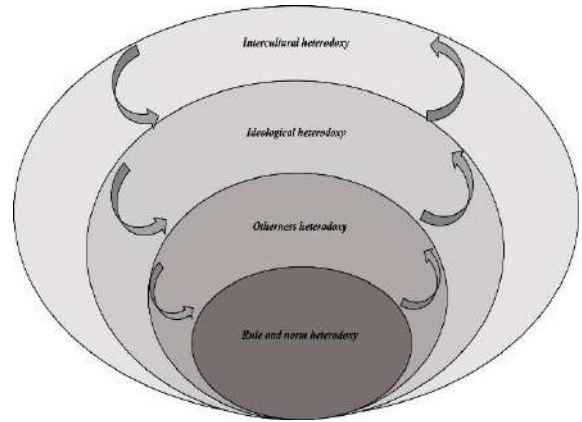


Figure 3: The cascading contexts for meaningful heterodoxies. (Source: Pidduck and Tucker, 2022)

Upon further analysis of the literature, it is evident that the R&E multiple compounding approach is based on the potential heterodoxy of entrepreneurship. Pidduck and Tucker (2022) highlighted two key aspects. The first aspect involves the movement of religious entrepreneurs' religious and cultural boundaries, which creates cultural barriers and conflicts for entrepreneurs, thus contributing to intercultural heterodoxy. The second aspect, defined as ideological heterodoxy, refers to discrepancies in deeply entrenched convictions and presumptions that may result in disputes. This aspect involves evaluating the deep assumptions and concepts of beliefs in the enterprise background in detail.

According to Smith et al. (2019), there are ideological conflicts that arise when assessing and pursuing economic opportunities due to the presence of different religious beliefs. These beliefs contradict established understandings of the relationship between religion and business. Another aspect is otherness heterodoxy. This involves considering opinions that deviate from expectations (Pidduck and Tucker, 2022). Otherness heterodoxy examines how faith-based thinking deals with skepticism and foreignness. Figure 3 illustrates the cascading contexts for meaningful heterodoxies, explaining their approach to managing social identity, legitimacy, inclusion/exclusion, and code of behavior. To effectively communicate with stakeholders, entrepreneurs need to use effective communication strategies (Fisher et al., 2017).

7. NEUROSCIENCE AND ITS ADVANCEMENT WITH ENTREPRENEURIAL COGNITION

The latest studies in neuroscience have shattered existing myths about the relationship between neuroscience and entrepreneurship, offering a new perspective on entrepreneurial behavior and cognition. Generally, entrepreneurs start by generating new ideas and then turning those ideas into profitable enterprises. However, this seemingly straightforward process involves a deep cognitive process. According to Shane, Locke, and Collins (2003), uncovering hidden advantages in new opportunities involves a cognitive transformation of an idea into a business. Thus, every new enterprise established today undergoes a profound cognitive process, beginning with a brainstorming session to create a product or service, identify the business's potential, and allocate its resources (Baron, 2007).

In discussions about entrepreneurship, the creativity of the entrepreneur is an important characteristic for generating ideas from various sources and turning them into profitable business ventures. This creativity is rooted in cognitive processes, as explained in cognitive science. According to Baron (2006), cognitive science involves studying pattern recognition and meaningful occurrences or changes. Baron and Ensley (2006) found that individuals with a strong cognitive framework are better at recognizing new patterns and business opportunities, and this ability is closely linked to the cognitive process. This understanding can improve the entrepreneurial mindset and dedication to pursuing new opportunities.

8. PRISMA FRAMEWORK

A significant way to identify potential entrepreneurs is by evaluating the business environment and establishing a venture. This approach is based on the well-structured framework defined by Mitchell et al. (2002) and is associated with entrepreneurial cognition. The study used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework and VOS viewer to create network maps and a comprehensive framework for neuro-entrepreneurial education. It emphasized the

use of neuroscientific techniques such as EEG and fMRI to study entrepreneurial cognition and behavior.

Articles were selected using the PRISMA framework and the Ryyan Systematic Review tool. Initially, 161 articles were found in the databases. After removing 60 articles due to duplication, ineligibility, and other reasons, 41 articles were considered eligible for screening. Out of these, 40 articles were excluded during screening and 20 articles could not be retrieved. This left us with 41 articles for further assessment. However, 26 reports were excluded as they were not primary research and were unavailable for analysis. Finally, a total of 15 articles met the inclusion criteria for critical review (see annexures 1, 2, and 3).

The Ryyan tool involves collaborators and a reviewer in deciding which articles to include or exclude based on specific criteria. The tool automatically filters out irrelevant articles and the final decision on which articles to include is exported from Ryyan.

9. CLUSTERS OF NEURO-ENTREPRENEURSHIP EDUCATION

The VOSviewer network maps demonstrate an attempt to visualize the components and their connections within neuro-entrepreneurship education. The analysis depicts two networks. Figure 4 displays the standard mapping, representing the two main elements of neuro-entrepreneurship education, "cognitive neuroscience" and "entrepreneurial introduces "neuro-entrepreneurship education" as the integration of the two main elements mapped separately in Figure 4 below.

The elements depicted in Figure 4 are not commonly emphasized in traditional entrepreneurial education. However, the networks illustrate the significant connections between neuroscience, decision-making processes, behavioral science, and technical tools such as Functional Magnetic Resonance Imaging (fMRI) in contemporary literature. This suggests the possibility of merging cognitive neuroscience and entrepreneurial education. Subsequently, we created a network map outlining the potential elements of 'neuro-entrepreneurship education'.

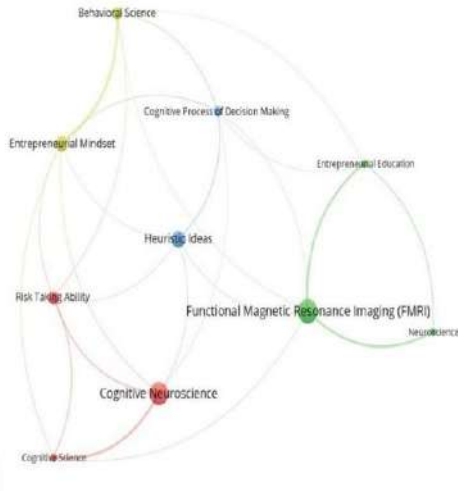


Figure 4: Mapping cognitive neuroscience and entrepreneurial education (Source: Authors' preparation using VOS viewer)

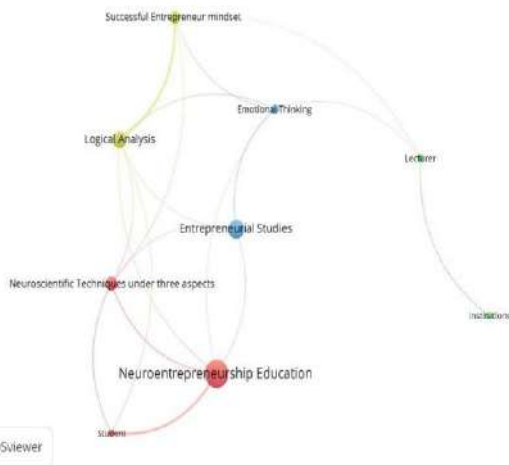


Figure 5: Mapping neuro-entrepreneurship education (Source: Authors' preparation using VOS viewer)

The map emphasizes the importance of a student-centered approach, which is vital for developing an entrepreneurial mindset by integrating key neuroscientific techniques with entrepreneurial education. These network maps are valuable for gaining insights into creating a framework for neuro-entrepreneurship education and its development. Additionally, incorporating interdisciplinary aspects into entrepreneurial education, and establishing strong connections between institutions and students, as well as emotions and logical analysis, are crucial for developing a more practical and adaptable model

and framework for entrepreneurial education today.

The education system plays a crucial role in shaping prospective entrepreneurs. However, in the Sri Lankan context, there are limitations to its impact on neuro-entrepreneurship. Factors such as early childhood experiences, particularly trauma, genetically endowed personality traits, and environmental influences significantly influence career choice. These factors can overshadow the effects of educational interventions, meaning not all educational efforts will necessarily result in the production of entrepreneurs. Addressing these influences requires a holistic approach beyond the education system to foster an entrepreneurial mindset effectively. Therefore, while the purpose of education is to create the potential for entrepreneurship, it cannot guarantee that all individuals will become entrepreneurs.

10. CONCLUSION

The study's results highlight the potential of integrating neuroscience into entrepreneurship education, particularly in developing Asian nations. The findings emphasize the importance of interdisciplinary collaboration by revealing a strong relationship between brain activity, entrepreneurial behavior, and mindset. To better understand specific features of entrepreneurial behaviors, the study recommends incorporating behavioral applications such as transcranial magnetic stimulation. It elucidates the cognitive factors influencing decision-making and underscores the importance of neuroplasticity.

The study not only provides a deep understanding of cerebral hemispheres and encourages multidisciplinary insights for a comprehensive understanding of entrepreneurship, but also advocates for a shift towards a neuroscientific perspective. It emphasizes the importance of integrating neuroscientific techniques into education for those aspiring to become entrepreneurs. A more advanced understanding of entrepreneurship is made possible by gaining insights into decision-making processes, risk-taking behavior, and the entrepreneurial mindset.

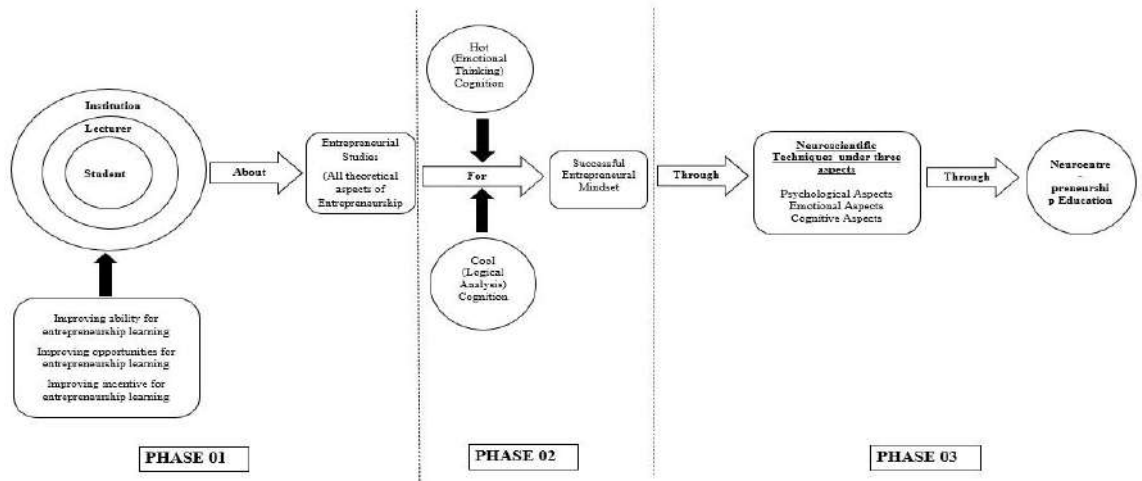


Figure 6: Proposed Entrepreneurial education framework for Neuro-entrepreneurship

(Source: Authors' preparation)

The study emphasizes the importance of understanding the brain's role as a micro-antecedent of human behavior and decision-making for aspiring business owners to successfully navigate the challenges of the entrepreneurial journey. It also highlights the increasing significance of neuroscientific tools such as ERP, fMRI, EEG, and eye tracking in the study of entrepreneurship. The study underscores the value of experimental methods in improving entrepreneurial theory and establishing causal relationship.

The conclusion emphasizes the importance of further research into the intricacies of entrepreneurial cognition. It recognizes that as neuroscience-related studies increase, prospective business owners have more opportunities to enhance their understanding of entrepreneurial thinking. This research suggests that neuro-entrepreneurship can be a viable strategy for cultivating a comprehensive entrepreneurial mindset in Asian nations. It calls for a shift in the field of entrepreneurship education.

The practical applications and investigations can help make neuro-entrepreneurship a viable strategy through various methods such as research, experimental games (e.g., BART game, dictator game, and real effort task), pilot programs in educational institutions, neurofeedback and cognitive training, mindfulness and stress management workshops, cross-disciplinary collaborations with neuroscientists, psychologists, and entrepreneurial ecosystem management.

In Figure 6, the pedagogy of entrepreneurial education within the university system consists of three levels: the institution at the first level, lecturers at the second level, and finally a student-centered phase. All these levels are influenced by improving the ability for entrepreneurship learning, improving opportunities for entrepreneurship learning, and improving incentives for entrepreneurship learning. These improving dimensions tend to explain the "about" approach, which emphasizes theoretical education and the traditional way of teaching entrepreneurship. This phase represents the traditional way of entrepreneurial education that has taken place in Asian countries.

The study by Ghina et al. (2017) departs from the traditional "about" and "for" approaches and instead adopts a "through" approach. They develop a new framework based on the theoretical model, incorporating key dimensions and neuroscientific techniques. In the second phase, the focus shifts to the "for" approach, emphasizing the practical application of entrepreneurial theories in real-world contexts to support a successful entrepreneurial mindset.

The study also discusses "hot cognition," which refers to decision-making and cognitive processes influenced by emotions, in contrast to "cool cognition," which is more analytical and less influenced by emotions. Despite the limited availability of these techniques in local contexts, the third phase of the study emphasizes the application of

neuroscientific techniques in three aspects: psychological, emotional, and cognitive.

The psychological aspects refer to the mental processes and behaviors that contribute to an individual's thoughts, feelings, and actions. Techniques such as FMRI, EEG, and MEG are applied to study emerging entrepreneurial education. Emotional aspects involve subjective experiences, expressions, and the regulation of emotions, using FMRI, Positron Emission Tomography (PET), and Heart Rate Variability (HRV) monitoring in the field of neuro-entrepreneurship. Cognitive aspects involve mental processes such as perception, attention, memory, language, problem-solving, and decision making. These aspects capitalize on the use of FMRI, Event-Related Potentials (ERPs), and TMS. This approach emphasizes a pedagogy of education revolutionized with the experimental application of neuro entrepreneurship education, focusing on the idea of "through" rather than "for" or "about".

The study's key findings show the significant impact of incorporating neuroscientific techniques into entrepreneurship education, especially in developing Asian countries. This integration combines cognitive neuroscience with entrepreneurial mindsets and behaviors. While the study emphasizes the importance of interdisciplinary collaboration, it also recognizes limitations such as the influence of early childhood experiences and genetic traits on entrepreneurial outcomes. Despite these challenges, the research offers valuable insights into the neural basis of decision-making and risk-taking in entrepreneurship, contributing to a broader scientific understanding of entrepreneurial cognition. The implementation of this framework is feasible when applying neuroscientific techniques using behavioral experimental models and applications. Future research can further explore these interdisciplinary approaches and address the practical implications for educational frameworks and policy development in fostering a comprehensive entrepreneurial mindset.

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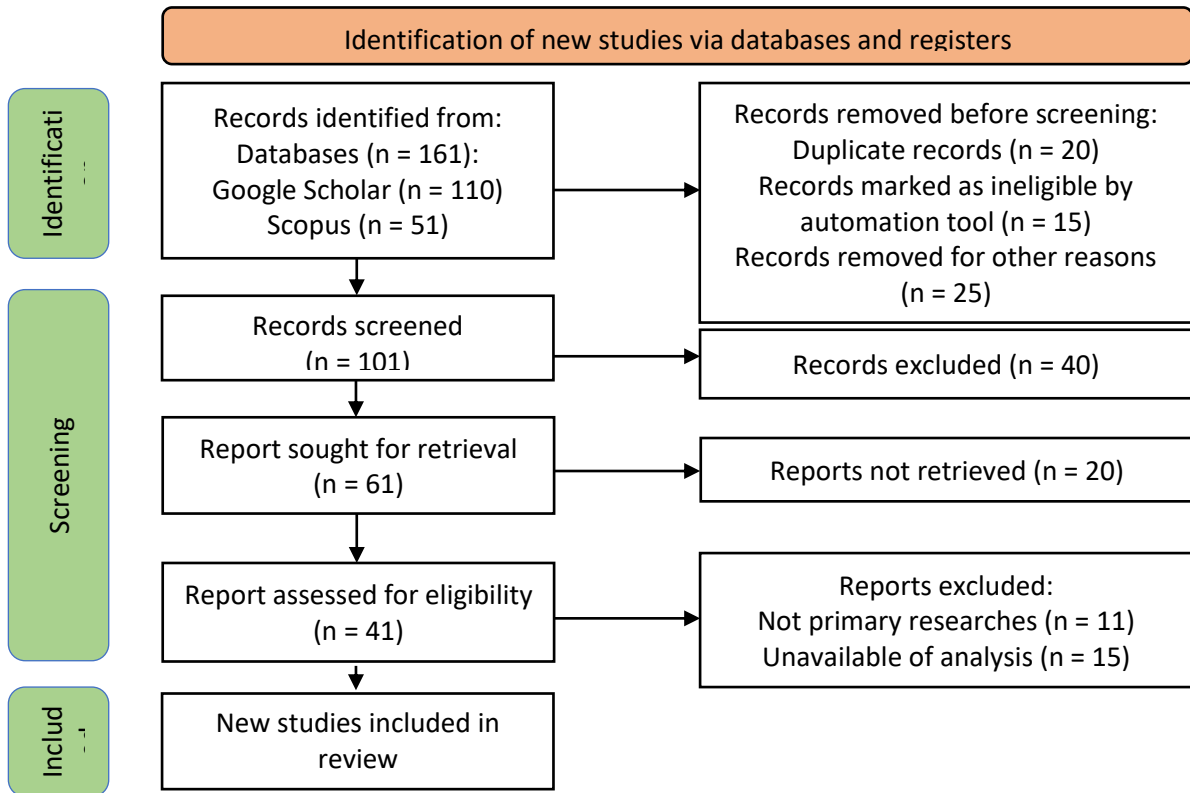
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12. ANNEXURES

Annexure 1: PRISMA (Preferred Reporting Items for Systematic Reviews) framework



Annexure 2: Sample of Ryyan tool



Annexure 3: PRISMA-stages

Stage	Number of Articles Identified	Number of Articles Screened	Number of Articles Eligible	Number of Articles Included
Initial Database Search	161	141	126	101
Duplicates Removed	20			
Removed for other Reason	25			
Titles and Abstracts Screened		101	61	41
Articles Excluded (with reasons)			Not primary researches: 11, unavailable of analysis: 15,	
Articles included in review			15	15