

# Nurturing Neuroplasticity as an Enabler for Growth Mindset through Lifelong Learning and Knowledge Dynamics

Roxana-Maria STANEIU\*

National University of Political Studies and Public Administration (SNSPA), Bucharest, Romania

\*Corresponding author, roxana-maria.staneiu@facultateademanagement.ro

**Abstract.** *In a world where change and uncertainty prevail, one's ability to take full responsibility for the development of their own brain renders itself as a propensity to increase neuroplasticity by engaging in mentally challenging endeavors to be broader stimulated. Being an in-built human ability, which enables the brain to reorganize pathways and create new synapses at all times in people's lives by accumulating new information through experiences, neuroplasticity offers people the opportunity to rewire their behaviors by constantly learning to expose to new contexts and be creative in front of challenging and complex situations. Following an empirical analysis of the literature review covering neuroplasticity, growth mindset, lifelong learning and knowledge dynamics, the paper aims to reveal the connection between these forces and understand the influence each other plays in stimulating the brain, increasing its capacity and ensuing an enhanced personal and professional development. The results showcase an organic connection between neuroplasticity, growth mindset, lifelong learning and knowledge dynamics which illustrated itself in the shape of a research diagram, emphasizing the interconnections and the prevalent role of knowledge transformations.*

**Keywords:** Neuroplasticity, Knowledge Dynamics, Growth Mindset, Lifelong learning

## Introduction

In today's era where uncertainty presides over, our innately human ability to grow and adapt has been proven more useful than ever (Bolisani & Bratianu, 2017; Morriss et al., 2022; Sharma et al., 2020). Our brains are pre-wired with a bias to constantly learn and be receptive to new experiences, knowledge and adapt to challenging environments. It is thought that we are not born with a fixed amount of intelligence, but our brain changes and stretches over time to form new neurons and build stronger and stronger neural networks, also known as synapses. Commonly referred to as neuroplasticity, this in-built human ability enables our brain to reorganize pathways and create new synapses at all times in our lives by accumulating new information through experiences, constantly learn by exposing to new contexts and be creative in front of challenging and complex situations (Guglielman, 2012; Boaler, 2013).

One's desire or propensity to learn is not enough if this is not nurtured with the help of a growth mindset – an enabler for enhancing abilities and competences by believing that everything can be learned with dedication, hard work and discipline, turning mistakes into valuable sources of knowledge. Believing that there is no fixed intelligence, and any skill can be improved through practice, discipline, and repetition, alongside getting outside the comfort zone to challenge oneself and be exposed to new learning context is essentially important for someone who wants to adopt a growth mindset (Dweck, 2006; 2016).

The fuel for both growth mindset and neuroplasticity is life-long learning, choosing to challenge the mind by serving our human natural curiosity by performing activities to improve the knowledge, skills and overall experience. Learning should not be limited neither to the childhood years, nor only formally manifested, but it should be promoted as a sustained and constant activity throughout the entire life, rendering itself as the cornerstone of brain's ability to evolve and adapt

to changes and employing a growth mindset The more one perseveres to learn something, following multiple trials and error while learning from mistakes, the stronger the new neural pathway will be, leading to an increased neuroplasticity and an active brain, ready to adapt faster to new challenges and better cope with difficult life situations (Patterson, 2022).

The current paper's objective aims to present a holistic theoretical background on *Neuroplasticity, Growth Mindset, and Life-Long Learning* and highlight the connections between these concepts in a scheme that is glued together by the influence of Knowledge Dynamics (Bratianu et al., 2021). In the light of this paradigm, the research question of this present study is the following:

*RQ1: How Neuroplasticity, Growth Mindset, and Life-Long Learning connect under the umbrella of Knowledge Dynamics to foster one's personal and professional development?*

To answer the abovementioned question, the paper outlines the most important notions for each concept, following a comprehensive literature review, and emphasize how they interact and connect to nourish the idea that our inherent ability to change our brain could be harnessed and develop not only to improve our knowledge, skills, and performance, but also to help us transform uncertainty and challenges from obstacles to fuel for life-long learning. The originality element of the present paper lays on bringing together the triad of concepts supporting continuous brain development, namely neuroplasticity, growth mindset and life-long learning, while investigating how knowledge dynamics may influence this relation and how rational, emotional and spiritual knowledge transformations are stimulated throughout the entire process.

Regarding the structure of the current paper, it can be observed that it is organized as follows: the introduction will be followed by the theoretical analysis that shall draw attention to the literature review covering the main concepts and the relation between them. The next step will be to emphasize the methodology taking shape as the research diagram which reveals the connections between Neuroplasticity, Growth Mindset, and Life-Long Learning under the umbrella of Knowledge Dynamics and discuss the results and implications. Lastly, the paper further outlines the reached conclusions, covering limitations and other possible future research directions.

## Literature review

### *Neuroplasticity*

Being referred to as plasticity avant la lettre by James (1890) and formally introduced and conceptualized by Konorski (1948), neuroplasticity refers to brain's ability to change, modify or reorganize in response to experiences for the purpose to better adapt to new situations. It is perceived as a complex process which implies adaptive structural and functional changes to the brain, revealing that neural networks are not genetically predetermined and fixed, but they are constantly forming and evolving throughout the entire life (Demarin et al., 2014). Neuroplasticity is considered one of the most important discovery in neuroscience and its definition can be summarized as "the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections" (Mateos-Aparicio & Rodríguez-Moreno, 2019, p. 66).

It has been discovered that there are various types of neuroplasticity, grouped under different criteria, but the most common ones are structural and functional neuroplasticity. According to Ackerman (2021), structural neuroplasticity refers to the changes occurred in the strenght of the synapses (the connection between two neuros), whilst the functional neuroplasticity implies permanent changes in synapses as a result of activites related to learning and memory

exercies. In other words, structural change takes place when neurons change or adapt their network, which cause physical altering of the brain's structure. It is a process that requires effort and time and it can happen under various forms, such as groth or loss in the number of neural connections, increased strenght of synapses, the formation of new pathways between neurons or even the birth of new neurons also knows as neurogenesis (Demarin et al., 2014). Looking at functional neuroplasticity, its main differentiator resides in the fact that it involves significant changes in the entire neuronal network: once learned, the new connection between neurons becomes stronger and stronger with time, having the ability to weaken the old one and eventually turn into a routine. To make an analogy, it is similar to create a new pathway on an unexplored road: the more you walk on the same path over and over again, the more familiar and easier to access it gets (Ackerman, 2021; Orenstein, 2019).

Another aspect worth mentioning is the connection between neuroplasticity and intelligence, namely how structural and functional neuroplasticity maps on crystalized and fluid intelligence types. Crystallized Intelligence refers to the ability to employ skills and recall knowledge that were acquired via prior learning and past experiences, while Fluid Intelligence is founded on the ability to learn new things quickly and use critical thinking to resolve abstract and complex problems, using more creativity and adaptability rather than facts or accumulated information (Cattell, 1963). Crystallized Intelligence increased over time and it involves structural changes to the brain provided the formation of new neurons or synapses through learning and memory, while Fluid Intelligence fosters the ability to find solutions without consciously taking into account pre-existing knowledge, which consequently results in new strong neural pathway and functional changes (Tomlinson, 2021).

To increase neuroplasticity positive effects, one can engage the brain in challenges tasks, learn a new language (Pliatsikas et al., 2017) or even dance (Teixeira-Machado et al., 2019). Moreover, it has been discovered that sleep and physical activity play a significant role in nurturing neuroplasticity (Vorkapic et al., 2021; Hötting & Röder, 2013; Brühle et al., 2021; Liu & Nusslock, 2018; Dickson, 2010; (Palagini et al., 2022) Also, Voss et al. (2017) found out that neuromodulator systems, the ones responsible to regulate diverse populations of neurons through specific chemicals, such as dopamine, serotonin or noradrenaline, are drivers of neuroplasticity. Lastly, mindfulness techniques, such as meditation or breathing exercise, has been identified as a pillar to produce neuroplasticity (Braboszcz et al., 2013; Hanson, 2017; Yu, 2021).

### ***Growth Mindset***

For many years, society perpetuated the belief that the intelligence is a given trait, and it stops developing in the first years of life, leading to a fixed amount of intellectual capabilities for each person. Although there certainly are some inherent individual propensities and predispositions towards a particular subject or talent, one's intelligence is defined by their experience and exposure to information, together with the learning process to acquire new knowledge. This aspect highlights that everyone can grow or develop any skills as long as they work hard, they are determined and they stay consistent in front of learning obstacles and challenges – this is the essence of the growth mindset, a concept developed by Dweck (2006) after years of observing how students learn.

The mindsets' theory brings into the spotlight a duality in terms of how one's brain can work: on one hand, individuals who adopt a fixed mindset think that intelligence cannot be developed, that talent comes above hard work and dedication, that making mistakes can completely hijack their self-worth and they focus more on preserving a perfect image fed by flawless results. On the other hand, people who embrace and develop a growth mindset believe that the intelligence

can evolve through the entire life with each lesson learned, that any competence can be learned by putting in the passion, the work and the discipline, that making mistakes is an quintessential part of learning as they enhance the entire process and they focus more on the development journey and how they transform their brain, rather than just achieving the results (Dweck 2006, 2016; Dweck & Yeager, 2019).

Taking into account how growth mindset is perceived at a functional brain level, it conveys the idea that intelligence is malleable and improvable, going hand in hand with neuroplasticity. Patterson (2022) identified five tenets of growth mindset: neuroscience, as brain areas responsible for noticing, attention and mastery are more active for students who have a growth mindset; error culture, meaning that the attitude towards mistake is a positive one and they are essential and innate to the learning process by examining them fully, not ignoring them; behavioral traits, translating into encouraging a more productive goal setting; motivation, as growth mindset stimulates intrinsic motivation; academic achievement, in regards to the fact that when the students succeed in getting high results, they are motivated to work more not only to preserve it, but also to improve it (Yeager et al., 2019).

With regards to nurturing a growth mindset in organizations, Han & Stieha (2020) distinguished between individual-level (growth mindset perpetuates higher engagement, improve task performance and promote creative activities), dyadic-level (growth mindset improves the feedback loop from one individual to a team and vice-versa, facilitating coaching and better collaboration), and organizational-level outcomes, where leaders' growth mindset not only fosters positive relations, encourages innovation and better collaboration, but also sets the cornerstone to create a culture of organizational learning. Nevertheless, growth mindset is not enough for an organization to integrate learning in its DNA. In order to create a comprehensive strategy for turning into a learning organization, on top of growth mindset, a company should also focus on vision and business opportunity, knowledge structure and knowledge transfer, knowledge creation and acquisition, training programs for employees, business analyses and innovation support (Bratianu & Leon, 2015; Bratianu et al., 2020). In addition to this, a closer look at the intellectual capital is required insomuch as human and relational capital plays a significant role in organizational achievements through proactive engagement alongside network's intangible resources, which is a sign of the growth mindset (Vătămănescu et al., 2022).

### ***Lifelong Learning***

It is said that the future belongs to the ones who never stop learning, as engaging in a continuous process of exploration, discovery and growth make the brain more plastic and easier to adapt to challenges or uncertainty. In the UNESCO Education Sector Communication Paper, lifelong learning is defined as a process which “is rooted in the integration of learning and living, covering lifelong (cradle to grave) and life-wide learning for people of all ages, delivered and undertaken through a variety of modalities and meeting a wide range of learning needs and demands” (UNESCO Institute for Lifelong Learning, 2021, p. 1). Lifelong learning is based on four main principles which is supposed to guide the entire society, independently of age, race or wealth, to enroll in never-ending learning to prosper and innovate: learning to be, to know, learning to do, learning to live together.

The fundamental essence of lifelong learning resides in the innate integration of living and learning, in the sense of learning should take place throughout the entire lifespan, from childhood to elderly ages and it should be promoted not only in schools, but also in other social contexts, such as family, workplace, community etc. (Laal, Benefits of Lifelong Learning, 2012). Lifelong

learning implies acquiring new information and new knowledge acquisition, as well as developing a more in-depth understanding of various environments and context in order to employ these lessons with creativity, confidence and discipline to generate innovation and create new opportunities over the course of the years (Bryce et al., 2000). Lifelong learning may be also perceived through the lenses of formal learning (which happens inside an organization, such as school or workplace), non-formal learning (this type of learning derives from challenging tasks or context which are not primarily designed for learning, but their level of complexity comes together with invaluable learning experience), and informal learning (which is encouraged every day through the social activities a person takes part of, as well as the social contexts they are exposed to such as family, spare time etc.) (Preece, 2013).

In terms of lifelong learning benefits, according to CanLearn (2009) identified three main advantages of keeping oneself in a constant learning state: it provides the person with the change of acquire and find out relevant information and knowledge to evolve and grow, in order to prosper in society; it allows communities to react faster and better to change, as change is the only constant in today's knowledge economy world; it makes the economy stronger by having more and more trained and skilled people working and sharing their knowledge, teaching others and learning from each other. In addition to this, engaging in a lifelong learning routine contributes to sharpening the mind, which correlates to increased neuroplasticity and growth mindset as a vehicle. It can also improve confidence, career opportunities and interpersonal skills (Laal & Salamati, 2012).

In organizations, a culture of knowledge sharing renders itself as a valuable context for people to engage in lifelong learning and strengthen the knowledge management strategy. Knowledge sharing is considered a "voluntary process by which an individual is willing to share some of his or her knowledge and experience to other people when there is a climate of trust and common interest" (Bratianu, 2019, p.362). Apart from the inherent openness to exchange information from one to another, knowledge sharing thrives in a company where organizational culture, high level of trust between people and a healthy reward systems come together to facilitate the activities that define knowledge sharing (Alexandru et al., 2020; Vătămănescu et al., 2015, 2018, 2019, 2020, 2021). An organization which defines a clear knowledge management strategy and constantly creates contexts for learning and development is an organization where people will feel more open to be part of their own lifelong learning journey.

### ***Knowledge Dynamics***

If the first wave of metaphors to explain the concept of knowledge employed in the source domain objects or stocks (Bolisani & Oltramari, 2015) and the second wave make the transition to fluids, flow or stock-and-flow (O'Dell & Hubert, 2011), Bratianu & Andriessen (2008) introduced a new metaphor to explain the organizational knowledge which was centered around energy: just like energy, the knowledge is a field, which manifests in various forms, where one form can take shape or transform into another form. It is also considered to be an open system, which makes it susceptible of knowledge loss or acquisition and its studying objective gravitation around knowledge transformation process. Knowledge dynamics is preoccupied with all these transformations (Bratianu, 2018).

There are three fundamental forms of knowledge: rational knowledge, emotional knowledge and spiritual knowledge. The rational knowledge has an explicit trait, and it can be expressed through natural language or symbols. The emotional knowledge is the one which is the most related subconscious mind, and it is represented by the feelings and emotions people experience once they are exposed to a situation, evolving from the primary concern of the human

brain: survival. Lastly, spiritual knowledge aggregates the entire spectrum of values, beliefs and states of mind that are being experienced within an organization (Bratianu, 2018; Bratianu & Bejinaru, 2019). It's important for an organization and its people to understand know these transformations are taking place and, more importantly, know a growth mindset and neuroplasticity facilitate the knowledge dynamics and the associated benefits. A relevant example is that it has been showed that integrating emotional and spiritual knowledge in decision-making process makes a positive difference for managers in terms of the quality of final decisions (Bratianu et al., 2020). Another important aspect which proves significant to be taken into account is related to the knowledge entropy within an organization, which allows to measure the level of order within the organization. If the organization has a flat organizational culture, registers an exponential growth and develops at a high pace, then the level of entropy is high, indicating a significant number of spontaneous contexts that appear on a regular basis, but also indicating a context where creativity and nonlinear thinking thrives, which results in an environment where growth mindset is nourishing. Moreover, knowledge sharing has a positive influence of knowledge entropy in the sense of the more people will have access to the same knowledge within the organization, the higher the entropy, leading to more innovation, more lifelong learning contexts and more brain plasticity by creating new neuronal pathways (Bratianu & Bejinaru, 2019; Bratianu, 2019).

### Methodology

The abovementioned analysis of the current literature on the connections between neuroplasticity, growth mindset, life-long learning knowledge dynamics enabled the creation of a theoretical framework highlighting how these forces interact. The methodology is considered to be qualitative, following empirical observation to take into account the previous results in order to put together a new way of illustrating the impact of these concepts working together towards increasing brain plasticity and personal and professional development.

### Results and discussions

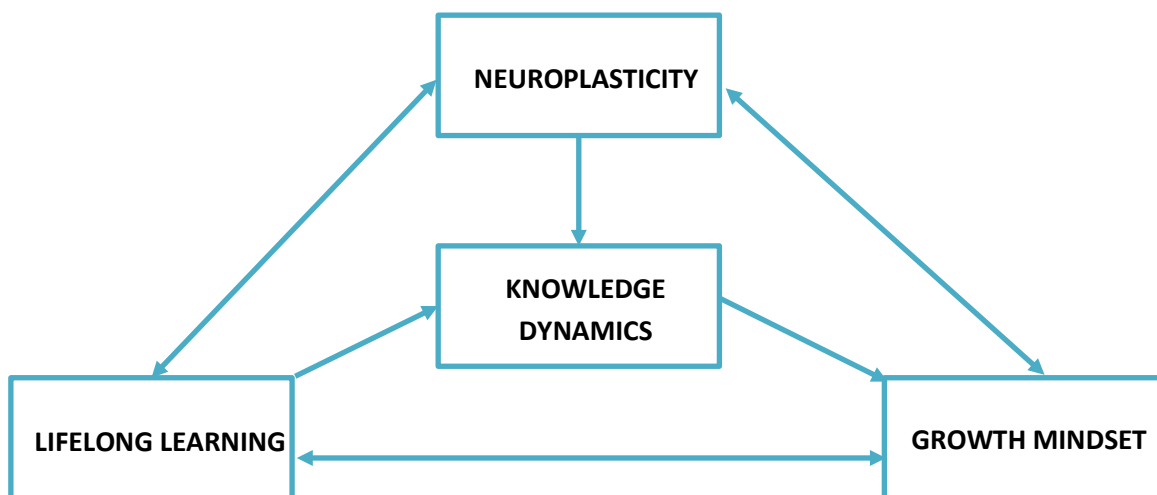


Figure 1. Interconnected model of neuroplasticity, growth mindset, life-long learning knowledge dynamics

Source: Author's own research.

It can be observed growth mindset, lifelong learning and neuroplasticity interact together under the forces of knowledge dynamics within an organization, each one representing an incentive for the other. Having a growth mindset and looking at intelligence as something that can be developed, especially through analyzing errors and mistakes, hard work and dedication, leads to a disciplined lifelong learning by embracing the joy and content of incremental personal and professional growth. Moreover, lifelong learning is not only important for enhancing professional or personal traits, but it constantly gives the brain new information and acquires new knowledge relevant for its survival, which is the main human motivation. Therefore, the brain learns to adapt faster, to respond quicker to uncertain situations and to transform at a faster pace the emotional knowledge into rational knowledge to make better decision. Being in line with other similar studies, the interaction can also encourage intrinsic motivation (Ng, 2018).

Another aspect that could be included in the way organizations defines their development strategies for building people's buy-in is promoting the understanding how human brain works and what neuroplasticity means. If a person believes that she can increase the number of neuros or create new synapses to rewire unproductive, but old brain behaviors, then the changes of her adopting a growth mindset and takes part in lifelong learning initiatives are significantly higher. This result is in line with other researchers who identified the aspect of explaining how plasticity works as a prerequisite for growth mindset and lifelong learning (Goldberg, 2022; Cantor et al., 2021)

One essential aspect which should be considered when looking at the diagram and imagining how these processes connect with each other within a team or an organization is to keep in mind the game-changer incentive: getting out of the comfort zone. It is not just enough to do something that you are familiar with but challenge yourself to try out something that is characterized by uncertainty – this will translate into a mentally challenging task, the brain will be stimulated to think of new ways of adapting to the new situation, making functional changes. An essential lesson is that one's brain can be rewired, but it requires discipline in consistently applying the growth mindset and engage in challenging learning activities to stimulate the neuronal impulses in the brain. This observation is in line with Nordstrom & Merz (2006), who emphasized that lifelong learning set the foundation for a curious and hungry for knowledge mind.

Nevertheless, it is important to mention that growth mindset could be enhanced in order to generate more traction in lifelong learning and trigger neuroplasticity. Apart from mastering the knowledge dynamics principles and understand how each form of knowledge may transform into one another depending on the uniqueness of the situation, one can try to adopt three complementary characteristics that are thought to augment growth mindset: purpose, meaning that one is able to see the work as valuable to his evolution and find meaning it in; belonging, the feeling that one belongs to the community he works with; self-efficacy, the belief that one can have a high success rate at the new skill he tries to learn, trusting that he has everything to make it happen (Bowman, 2022). As it can be observed, all three complementary mindsets are from the emotional knowledge spectrum and once this is transformed to rational knowledge, it can serve as fuel to neuroplasticity, helping to build new neuronal pathway.

## Conclusion

In a world that requires constant adaptation and swift replies to the new challenges, you may embrace brain's natural plasticity and make the most out of the lesson taking into account that you can build a growth mindset which will lead to lifelong learning and neuroplasticity, making everything connected through the lenses of knowledge dynamics and transformations. The connection between these

concepts is not a singularity, as they interact on a multi-level approach, but it is true: you can develop a growth mindset if you desire to, you can train your mind to learn new things easier and become smarter and smarter; you can engage the brain and rewire it by focusing on new aspects to learn and keeping up the belief that everything can be developed and taught.

Following an empirical analysis and a comprehensive literature review, the paper aimed to offer an answer related to the connection between neuroplasticity, growth mindset, lifelong learning, mediated by knowledge dynamics in order to ensure personal and professional development. The paper manages to emphasize an answer by bringing into the spotlight the organic and mutual connection between neuroplasticity, growth mindset and lifelong learning, as one is enhanced by another, while knowledge transformation through knowledge dynamics is favored by the abovementioned harmony. Therefore, these concepts contribute to the brain's inherent inclination towards learning new information, a critical aspect of human nature that plays a vital role in our ability to learn, grow, and adapt over the course of our lives. Moreover, in the era of postmodernism, where there is a loss of confidence in knowledge production, the growing emphasis on lifelong learning calls for a rethinking of adult learning theory, connecting it to a growth mindset and the brain's ability to grow.

Regarding the limitation of the paper, it may be observed that the medical benefits of lifelong learning and neuroplasticity have not been highlighted, and it might have been interesting to notice how the ageing process is being influenced by the organic relation from the present paper. Therefore, another possible research direction for the future could be to include the impact of neuroplasticity on the aging process and understand what are the lifelong learning activities that keep the brain from degenerating after a certain age.

It is one's responsibility to take accountability for their own brain and make small, but consistent steps towards increasing brain capacity through neuroplasticity and lifelong learning: getting outside of the comfort zone, take risks, expose to unknown situations and challenge your mind to find creative solutions to novel context – this is the foundation for keeping your brain agile and making sure that when you step outside the comfort zone, you enter an enhancement zone full of opportunities and lessons.

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