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Original Research Article

NEUROSCIENCE OF ADULT LEARNING - NEUROANDRAGOGY

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Abstract:

Learning is the core of education. In the era of knowledge and technology lifelong learning is necessary.. For lifelong and continuous learning Androgy is the platform. As education is interdisciplinary, so the andragogy. Brain is the site of learning. so researches in neuroscience has the vital impact on education in general and learning in particular. How adults brain learns, functions and characteristics of it helps andragogy. Many important research results in neuroecience about neurogenesis, neuroplasticity, neurotransmitters, BDNF, synaptic pruning in adult brain proved vital use in androgogy to design learning program, instructional designs, and models for learning of adults.

Key words: *Neuroscience of Learning, Brain Based Learning, Andragogy, Neuroandragogy*

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Introduction:

Adult learning is different from child learning so for adult learning andragogy and for child learning pedagogy . Pedagogy has the effect of researches in neuroscience that is popularly known as Neuroscience of learning or Brain Based Learning .As brain is the natural habitat/ seat of learning. Andragogy deals with adult learning. When andragogy implements or utilizes the research results from adult neuroscience that is neuroandragogy. Prior to that it is important to know learning process in brain . Understanding how the brain works definitely influences learning of any age learner. Any educator, instructional designers, and eLearning professionals in general should be curious to know and understand brain from learning point of view as he or she educate the brain .

- **Learning process in Brain:**

Researches in neuroscience denotes that learning takes place in Central Nervous System (mostly in Brain) with the help of peripheral nervous system (sense organs)

Brain is pivotal organ in our body . There are 100 billion neurons. Cells in brain are called neurons . Each neuron has many fiber like processes. Those are called dendrites. One of them is longer than others that is called Axon. Neuron receives chemical/electrical signals from other body parts/sense organs and from our thoughts . Dendrites [short processes] functions as receiver of chemical signals (information). Axon(longer processes) transmits the chemical signals(information) from one neuron to the dendrites of another neuron; connection is created . that junction point of axon and dendrites is called synapses; so in Brain Based Learning ,Learning means – **"formation of Synapses, neural networks, neural pathways and long term memory.** Formation of more

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synapses means more learning. These synapses creates network of neurons in the brain; that is called neural network. More the dense neural network more developed brain and more learning eventually more development. Understanding of the learning process in brain help to enrich ,enhance and accelerate the learning .

- **Learning according to Neuroscience:**

Neuroscience denotes learning process should be -

according to brains natural learning process.
according to the characteristics of brain
regarding to principles of brain functioning.
keeping in mind fundamentals of brain functions.
regarding to the needs of brain.

Researches in neuroscience defines learning is a

1] continuous neuro- biological information processing in brain
2] physical process
3] innate, natural ability
4] involves whole physiology
5] both conscious and subconscious
6] unique in every brain

❖ **What should happen in Brain for learning:**

According to neuroscience following process take place in brain while learning

- **Neurogenesis** - Creation of brain cells "Neurons"
- **Increased Synapses** -creation of connections among neurons
- **Increased Neural Network**-Creation of networks of neurons through synapses
- **Increased Neural Pathways**- Creation of pathways of synapses connecting various lobes of the brain
- **Neuroplasticity** -flexibility of brain that allows brain to mould, change ,wire and rewire
- **BDNF**- it is substance or molecule in brain helps for neurogeneses
- **Secretion of Excitatory Neurotransmitters**-these are the chemicles secret in the learning process which enhance speed and quality of information processing /learning
- **Optimal brain engagement**- Enhanced communication among the parts of the brain .Above processes takes place in brain in learning process.

❖ **Brain Researches And Adult Learning:**

It was assumed that young person can learn easily than adults .So the famous marketing slogans "Learn a foreign language like a child," can be found easily. But researches in neuroscience proved that adult brain has also the ability to learn.

As neuroscience defines learning with empirical evidences ,in adult brain also the same processes should be taken place for meaningful learning. How to enhance these processes in adult brain for effective learning of adults can be scaffolded by neuroscience of adult learning that is neuroandragogy. There is a difference between

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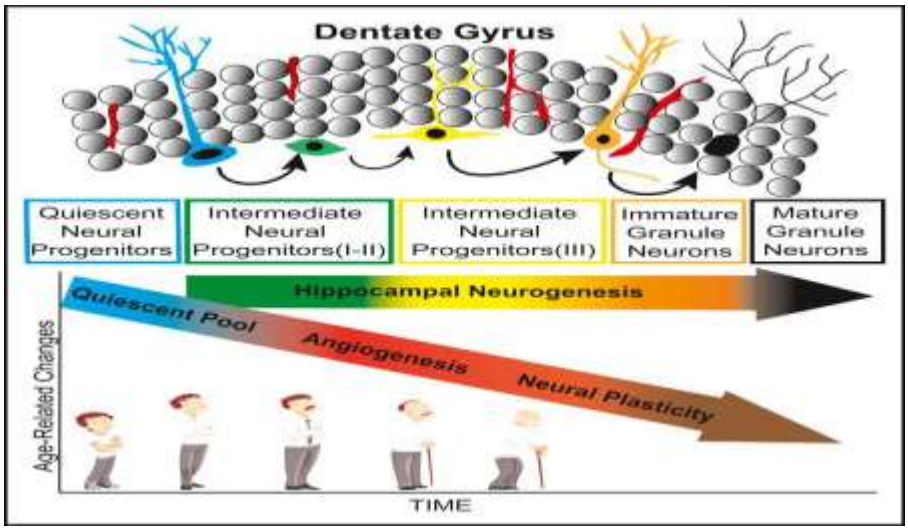
young brain and adult brains structure and function. ,so the difference between learning of children and adult. Following diagram shows the difference -

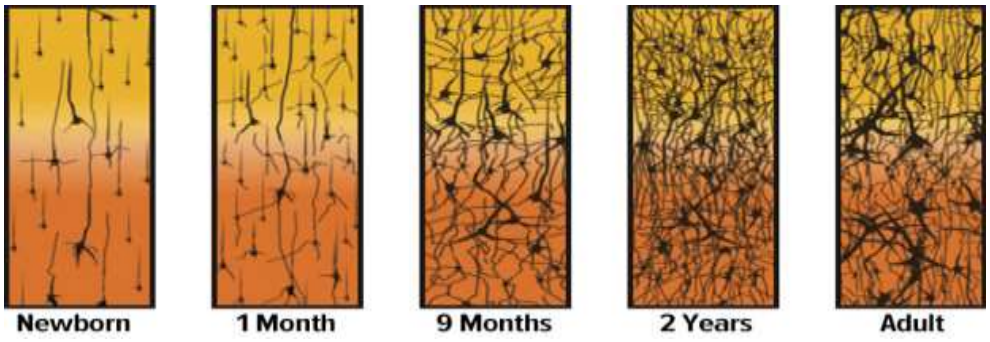


(Source-https://www.alzforum.org/news/research-news/newborn-neurons-adult-brain-real-deal-or-glial-imposters_)

❖ **Characteristics of Adult Brain:**

1) More white matter than grey matter:

Grey matter denotes the cell bodies of brain -Neuron. White matter denotes synapses ,neural networks and neural pathways ..Adult brain is more matured developed than young brain; so it is dense ,that can be seen easily in following diagram.



(source-http://www.urbanchildinstitute.org/why-0-3/baby-and-brain)

2) More developed pre- frontal cortex:

Adults prefrontal cortex is more developed than children. So they can think more logically, sequentially .So adults have complex and sublime emotions than children.

3) More control over the Amygdela:

Adults amygdela is controlled than children due to the more tracts from prefrontal cortex to Amygdela; so they can control their feelings and emotions.

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4) Decreased Synapse pruning rate

Adults brain prune the synypses and neural network very slowly; pruning is difficult in adult brain.

5) RAS(Reticular Activating System) is more selective and work on the rule of focused attention.

By using these characteristics of adult brain process in brain necessary for learning can be enhanced as follows.

1) Neurogenesis / BDNF:

Neurogenesis is the process of creating new neurons .BDNF (Brain Derived Neurotrophic Factor) is the important molecule necessary for neurogeneses.It was assumed that neurogenesis is active in child brain only and not in adult brain .But recent researches in neuroscience shows that adult brain also creates new neurons. In child brain rate of neurogenes is more and more part of the brain are engaged in neurogenese. But in adult brain rate and parts of brain involved in neurogenesis is less. Neuroscience shows that neurogeneses is possible in adults only in the part of the brain Hippocampus and olfactory bulb and motor cortex.

❖ **Strategigies to Enhance Neurogenesis in Adult Brain:**

As Hippocampus is the important part in brain for neurogenese, helping adults to create more long term memory is useful.For that mnemonics can be used. Researches suggest that the loss of hippocampal BDNF is not part of the mechanisms involved in age-related cognitive decline .**Neurons Those Fire Together Wire Together** (Hebb, D. O .1949)according to this rule peripheral learning is important ,so adults can be helped for this. Single tasking strategy is useful as it is proved in neuroscience that information processing is faster and accurate when brain works on single task. Multitasking decelerates the speed of information processing and prone to commit mistakes.

a) Physical Activity:

Researches in neuroscience proved that physical activities enhances neuroplasticity (Konopka L. M. 2015) .Exercise was also shown to improve brain functions. The biochemical molecule, BDNF, causes the growth and proliferation of neurons. It is experimented and established that exercise helps to provide oxygen and glucose to brain that increases neurogeneses.,. So adults should indulge in physical activities including walking ,exercise, aerobics ,running. According to one of the study (2006) cardiovascular fitness helps the brain tissue in not aging humans. There is strong biological basis for the role of aerobic fitness in maintaining and enhancing central nervous system health and cognitive functioning in older adults.

b) Proper Rest And Sleep:

Neuroscience shows that sleep and rest is mandatory for learning and memory as it strengths and consolidates synapses ,neural networks and neural pathways ;helps in creating and storing long term memory.(Eugene, A. R., & Masiak, J. 2015).Adults should have at least 7 hours of sleep for the proper functioning of their brain. Sleep is necessary to boost parts of the brain so that they can function normally and continually. Lack of sleep causes the malfunctioning of neurons.

c) Meditation: FMRI (functional Magnetic Resonance Imaging) shows that mediation helps to calm down the brain .According to Alice G. Walton(2016) mediation helps to preserve the brain from ageing. It helps to avoid depression ,anxiety and pain.

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2) Secretion of feel good Neurotransmitters

Feel good neurotransmitters helps brain effective, active and accelerate the rate of information transfer .Secretion of feel good neurotransmitters (Dopamine, serotonin, **Oxytocin** and Endorphin) is necessary for learning .Researches in neuroscience shows that some of the following activities can be utilized to secrete the feel good neurotransmitters.

- setting short term goals and fulfilling them.
- enjoying favorite food
- meeting interesting and new people visiting new places
- learning new language ,skill
- spending time with small children ,pets and loved ones.
- Engaging in Gardening ,exercise
- Pursuing hobby, exertion activity
- Helping others ,engaging in social works
- listing music, playing outdoor games.
- Any adult can make use of above strategies to help their brain to secrete happy neurotransmitters and make their brain ready to learn.
- These are the common suggestion that adults can use and learning program designer for adults should take into account for adults effective learning.

3) Neuroplasticity:

Brain changes physically continuously due to various conscious and unconscious experiences. In this it compensate its functions, changes synapses, neural network. It directs synaptic pruning, synaptic strengthening. Karla Gutierrez(2022) in her blog mentions that Neuroplasticity has weighty consequences, especially when it comes to learning. neuroplasticity allows the brain to change to improve to adapt and to learn throughout life, even after middle age and during old age. So adults can rewire their brain and can change their brain for their betterment . Bates, T.(2019) gives seven steps to rewire adult brain for getting red from negative thinking ,anxiety ,phobia**,** over thinking ,depression and make it flexible and productive .Following activities can be suggested for the adults to enhance brain plasticity which is necessary for learning.

1) Playing games
2) Learning new language or skill
3) Listening Music
4) Physical activity
5) Gardening
6) Doing things differently.
7) Practicing Mindfulness.
8) Solving and creating puzzles.
9) Practicing Visualizing

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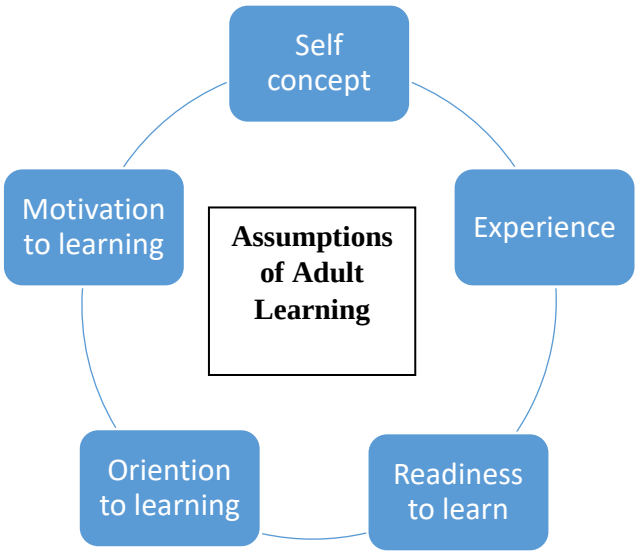
10) Practicing Imagination

All the above given activities help to change synapses, neural networks, neural pathways which helps to rewire the brain .

❖ **Application of Neuroscience in Androgoy:**

Adult learning is different from child learning. **Malcolm Shepherd Knowles** (1980) introduce the concept of andragogy. He gave five assumptions of adult learning they are shown in following diagram.



These assumptions have the neural correlates by using them instructor or educator of adult learner understand his/her role in andragogy and how to design learning of adults. Following table shows the same. .

Sr. no.	**Assumptions of Adult Learning.**	**Neural co relates**	**Instructors role**
1	Self concept	Developed prefrontal cortex	Choice should be given
2	Experience	Already created synyapses and neural networks and neural pathways	Design the learning according to created synyapses &neural networks ,neural pathways.
3	Readiness to learn	Controlled RAS so focused attention	Role of guide &mentor
4	Orientation to learning	Developed prefrontal cortex &Cingulate Gyrus	Responsibility & choice of decisions should be given to learner
5	Motivation to learning	Habituated RAS ,secretion of endorphin	Self learning task ,role of guide &mentor

Neuroscience has the ample impact on adult learning theory that is andragogy.Now the separate branch of this is prolife ring that is neuroandragogy.

References:

Alexander ,D. Jacob, Sheena, A,. Josselyn,(2020) Why Have Two When One Will Do? Comparing Task Representations across Amygdala and Prefrontal Cortex in Single Neurons and Neuronal Populations.

ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

VOLUME–IX, SPECIAL ISSUE – I NOV – DEC 2022

Original Research Article

Handbook of Behavioral NeuroscienceVolume26
https://www.sciencedirect.com/science/article/pii/B9780128151341000027

Bates, T.(2019) How to Rewire Your Brain: 7 Easy Steps to Master Neuroplasticity, Mind Hacking, Think Habits & Practical Neuroscience.

Bradley R. King, Philippe Saucier, Genevieve Albouy, Stuart M. Fogel, Jost-Julian Rumpf, Juliane Klann, Giovanni Buccino, Ferdinand Binkofski, Joseph Classen, Avi Karni, Julien Doyon, Cerebral Activation During Initial Motor Learning Forecasts Subsequent Sleep-Facilitated Memory Consolidation in Older Adults, *Cerebral Cortex*, Volume 27, Issue 2, February 2017, Pages 1588– 1601, https://doi.org/10.1093/cercor/bhv347

Brain-Derived Neurotrophic Factor: A Key Molecule for Memory in the Healthy and the Pathological Brain

Bransford,, J., D., Ed.; Brown, Ann L., Ed.; Cocking, Rodney R., Ed(2000) How People Learn: Brain, Mind, Experience, and School. National Academy Press Washington, D.C.

Colcombe SJ, Erickson KI, Scalf PE, Kim JS, Prakash R, McAuley E, et al. Aerobic exercise training increases brain volume in aging humans. *J Gerontol A Biol Sci Med Sci.*

Dyer, A. (2019). The Neuroscience of Adult Learning: A Talk with Phillip Campbell. Boston Consulting Group. Retrieved from: https://www.bcg.com/publications/2019/neuroscience-adult-learning-talk-with-phillip-campbell

Eugene, A. R., & Masiak, J. (2015). The Neuroprotective Aspects of Sleep. *MEDtube science*, *3*(1), 35–40.

Ferman, S., Olshtain, E., Schechtman, E., & Karni, A. (2009). The acquisition of a linguistic skill by adults: Procedural and declarative memory interact in the learning of an artificial morphological rule. *Journal of Neurolinguistics*, *22*(4), 384-412.

Friederichs, A., (2018). How the adult brain learns: The importance of creating enriched environments when teaching. ***UNBOUND: Reinventing Higher Education*** (Spring 2018). Corballis, M.C., & Häberling, I.S. (2017). The Many Sides of Hemispheric Asymmetry: A Selective Review and Outlook. ***Journal of the International Neuropsychological Society, 23***, 710 - 718.Retrieved from https://unbound.upcea.edu

Hanna,J.L.(2015)Dancing to Learn: The Brain's Cognition, Emotion, and Movementhttps://www.cambridge.org/core/journals/dance-research-journal/article/dancing-to-learnhttp://www.comfsm.fm/socscie/biolearn.htm

Hart, L. A, (1983.)Human brain and human learning, Arizona, Books for Educators

Hebb, D. O. (1949). *The organization of behavior; a neuropsychological theory. Wiley*

Karla Gutierrez (2022). 8 Brain-Research-Discoveries-Every-Instructional-Designer-Should-Know-About. https://www.shiftelearning.com/blog/bid/324035/8-

Kempermann, G., Gage, F. H., Aigner, L., Song, H., Curtis, M. A., Thuret, S., Kuhn, H. G., Jessberger, S., Frankland, P. W., Cameron, H. A., Gould, E., Hen, R., Abrous, D. N., Toni, N., Schinder, A. F., Zhao, X., Lucassen, P. J., & Frisén, J. (2018). Human Adult Neurogenesis: Evidence and Remaining Questions. *Cell stem cell*, *23*(1), 25–30. https://doi.org/10.1016/j.stem.2018.04.004

Knowles, M. S. (1950) Informal Adult Education, New York: Association Press. Guide for educators based

ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

VOLUME–IX, SPECIAL ISSUE – I NOV – DEC 2022

Original Research Article

on the writer's experience as a program organizer in the YMCA

Knowles, M. S. (1984). Theory of Andragogy. https://d1wqtxts1xzle7.cloudfront.net/60934938

Konopka L. M. (2015). How exercise influences the brain: a neuroscience perspective. *Croatian medical journal*, *56*(2), 169–171. https://doi.org/10.3325/cmj.2015.56.169

Language-Learning-Rewires-Adult-Brain/Earning Rewires Adult Brain 2020 https://www.languagemagazine.com

Mark Tennant (2017) Facilitating learning with the adult brain in mind: a conceptual and practical guide, International Journal of Lifelong Education, 36:6, 745746, DOI: 10.1080/02601370.2017.1348583

Pallavicini, F., Ferrari, A., & Mantovani, F. (2018). Video Games for Well-Being: A Systematic Review on the Application of Computer Games for Cognitive and Emotional Training in the Adult Population. *Frontiers in psychology*, *9*, 2127. https://doi.org/10.3389/fpsyg.2018.02127

Społeczna Akademia Nauk (2018). Neoroandrogogy against exclusion. Retrieved from: http://www.neuroandragogy.eu/index.php/about-neuroandragogy/

Stiles, J., & Jernigan, T. L. (2010). The basics of brain development. *Neuropsychology review*, *20*(4), 327–348. https://doi.org/10.1007/s11065-010-9148-4

Wilson ,C. (2006)No One Is Too Old To Learn: Neuroandragogy: A Theoretical Perspective on Adult Brain Functions and Adult Learning. iUniverse 2021Pine Lake Road 100,Lincoln ,NE68512

Wilson, C. (2011). Neuroandragogy: Making the Case for a Link with Andragogy and Brain- Based Learning.

Wong, P.C., Perrachione, T.K. and Parrish, T.B. (2007), Neural characteristics of successful and less successful speech and word learning in adults. Hum. Brain Mapp., 28: 995-1006. https://doi.org/10.1002/hbm.20330

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