

REDEFINING EDUCATIONAL PRACTICES INTEGRATING INDIAN EPISTEMOLOGY AND MODERN COGNITIVE NEUROSCIENCES

COMPENDIUM OF PAPERS

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CONTENTS

Sl.No	Title	Contributor Name	Page No
I. Learning and Cognition: Indian Epistemological Concerns			
1	Exploring New Avenues for Knowledge : A Brief Note on Different Approach to Learning	Dr.Prem Khatry	1
2	Epistemological Beliefs in Accountancy : A study among Higher Secondary School Students	Dr. P. Usha	6
3	Learning and Acquisition- Indian Epistemological Concerns: Nyaya, Sankhya, Yoga	Dr. Deepa A. P	10
4	Epistemological and Pedagogical Concerns of Constructionism: Relating to the Educational Practices	Dr. D. Hassan	13
5	Epistemological Concerns of Stress: Relevance to Education	Bindu Gouri V. P Dr. M. Sadananthan	18
6	Cognitive Attainment in the Complex Texture of Indian Philosophy	N. K. Sunil Kumar	21
7	Theory of Epistemology in Naya Philosophy	Betty Sunny Rejithamol E.K	25
8	Learning and Cognition- The Indian Epistemological Concerns	M. S. Kala Swarna S. Sahaya Sija D. Anusha	28
9	Learning Cognition: Indian Epistemological Concerns	Kumari Bindu R. S	31
II. Neuro Scientific Bases of Cognition and Metacognition in Learning			
10	Peculiar Bent of Mind	Dr. R. Rajeswari	34
11	Attention: A Process of Cognition	T. Blessy Dr B. William Dharma Raja	37
12	Brain Cognition Behaviour: A Conceptual Analysis	Himna P.A. Irshana Shahnaz Ulladan	41
13	The impact of Cognitive Conflicts in Reducing Ontological Misconceptions on the basis of Metacognitive Approaches.	Nisha. S. Dharan	44
14	A Study on Metacognitive Learning Strategy on the Scholastic outcomes in Mathematics among Secondary School Students.	Jisha K. V.	47
15	Awareness of Metacognition among First Degree Students	S. Meenakshi Kirthika V. Sasikala	50
16	Metacognition in the Classroom and Beyond	A. Jasmine Agnal Geetha. N. R	54
17	Constructivism and Metacognitive Strategies to Promote Self-Directed Learners	Manju. M. S S. T. Sajith Lal Raj	57

18	Effectiveness of Metacognitive Affective Model of Self-Regulated Learning on Metacognitive Awareness of Students at Higher Secondary level	Dr. Minikutty A. Sindhu P. G	61
19	Education and Cognitive Neuroscience : An Overview	Dr. S. Payan P. Selvakatheeswaran	67
20	Metacognition	Dr. Karthy Jayakumar Issac Johnson	69
21	Exploring Neuroscientific bases of creativity	Dr. Sindhya V.	71
22	Developing Cognitive Strategies – Bricks for Learning	A. H. Anusooya Rukmani	76
23	Neuroscientific approaches of perception and cognition in learning	E. Gethsiah	78
24	Cognitive abilities for positive learning environment	Jose Brightly. H	80
25	Relationship between Cognition and Language Learning	Jaya S. R.	83
26	Cognitive Skills for Successful Learning	J. Jebila Dr. A. Beaula	85
27	Cognitive and Meta cognitive Strategies for Learning Disabled Students	Swapna K. S Dr. M. A. Sudhir	87
28	Cognitive Neuroscience: Key Processes and Techniques	S. Anithamary	90
29	Cognitive Neuroscience of Attention	Anitha Narayani. M.	93
30	Skills of Metacognition: An Overview	Jalin Mary Sheeba Selva Rani	96
31	Metacognition among Adolescence Students	M. Mary Sherli K. Jega	100
32	Enhancing Teaching Competency through Metacognition	R. S. Padma Rekha	102
33	Cognitive Skills and Brain Function	T. Srikarthick S. Meltorose , Dr. T. Vijila,	104

III. Neuro psychological aspects of learning

34	Cognition and Learning Neurological Aspects	Dr. S. Saravanan	106
35	Brain & The Mind	Immanuel Thomas	110
36	An overview on Neurotransmitters	Soya Mathew Dr. Betty. P. J.	114
37	Neuropsychological Aspects of Learning	V. Sundar Dr. K. Rajagopalan	117
38	Neuroplasticity: A Tool for Learning	Jeena E.M Dr A. Veliappan	119
39	How the Brain Learns Mathematics	Chandra Malar M. S. Pon Ambika Dr. Deepa R. P	122
40	Neuropsychological Assessment	Berlin Rajan	125
41	Psycholinguistics	Beena Florence Donark Angel Sukila Anitta Berin Jeya Sheela	127

42	The Key Concepts of Neuro informatics	V. Rajasree C. G. Chitra	129
43	Cognitive Dissonance: Logical techniques to reduce dissonance	D. Gladis Obeliea	132
44	Role of Educational Neuroscience in the field of Learning Disabilities.	Roshna V. Gopal Swapna. P	135
45	Neuropsychological aspects of learning	K. S. Shobha	138
46	Do cognitive distortions trim down brain function?	A. Linsey Cranab	141
		Dr. B. William Dharma Raja	
✓47	Helping children with cognitive disabilities	Dr. S. Praveen Kumar	144
✓48	Teaching Strategies for Children with Cognitive Disorder	Dr. Prema Latha. B	146
✓49	Effect of Yoga on Maximum Expiratory Pressure of Mentally Retarded Children	Dr. A. Ravi	149
50	Developing the cognitive abilities of learners with language learning difficulties	P. Renju	155
51	Importance of Neuropsychological Evaluation in Learning Disability	M. Kalai Selvi C. Hema M. Sobharani	158
52	Role of Neuro-Endocrine System in Stress mediation	Mohanraj. S Periyasamy. P	160
53	Cognitive Behaviour Interventions to redress Social Cognitive Deficits among Children with Conduct Disorder	Dr. Sony Mary Varghese Sheeja.R	162
54	Is Cognitive Dissonance affect Achievement in Mathematics? - A Survey among Higher Secondary School Students	Shimimol.P.S Dr. Hassan Koya M.P	164
✓55	Conflict Resolution Strategies of Adolescents	Dr. S. Sreelatha	167
✓56	Integration of Neuropsychology in Educational Planning following Traumatic Brain Injury	P. H. Jebalin Paul Dr. Mini Kumari V. S	170
57	Conflict Resolution Education Programs	M. Renukha R. Jacklin Jemi	174

IV. Designing Brain Compatible Learning Environments

58	Designing brain compatible learning environments	Dr. Leela Pradhan	176
59	Co-operative learning is an excellent Brain compatible Learning Technique- An Experimental Anaysis	Dr. C. M. Bindhu Niranjana .K	178
✓60	Brain Based Learning Strategy for developing Thinking Skills	Dr. Rajeswari .K	181
61	Brain Based Learning -An Active Processing of Information	Dr. Merlin Sasikala	185
62	Designing Brain compatible classrooms	Dr. Sreevrinda Nair .N	188
63	Creating Brain Compatible Classrooms through Experiential Learning	Dr. Sreekala K. L.	191
64	Brain-based Approach to teach English as a Second Language.	Sreekala S.	193
65	Whole Brain Learning - The Garden of Choices	Dr. Giby Geevarughese Anu Rachel Jogi	196
66	Designing Brain Compatible Learning Environments	Deepti Aggarwal	199
67	Knowledge, Perception and Implementation of Secondary School Teachers on Brain-Based Learning Strategy	Dr. A. Ananthi P. Narumanam A. Sevarkodiyon S. Lavanya	205

68	Compatible Learning Environment via Lower Order Cognitive Abilities	Amudha Asaph	208
69	Six Elements of a Brain Compatible Classroom	Dr. B. William Dharma Raja	211
70	Brain Compatible Learning Environments	Arsha N.	213
71	Brain Compatible Learning Environment	Aji R.	215
72	Brain Based Approach to Ignite Learning	Priya S.	218
73	Brain friendly classrooms for better Achievement	Remya M. V.	221
74	Development of a Brain Compatible Classroom	S. Rajalakshmi	225
75	Effectiveness of Graphic Organisers for Learning Economics at Higher Secondary School Level	V. Deepthi	227
76	Nourishment of Learning: An act of Survival	V. Sasikala	230
77	Brain Compatible Constructivist Classroom Strategy Based on Eisencraft's Fundamentals of Teaching and Learning	Dr. M. Maria Saroja	233
78	A Comparative Study On Brain Based And Ancient Indian Epistemology Based Teaching In Developing Cognitive Outcomes Of Secondary School Students	Anupamamol M. K	237
79	Change the classroom through Brain Based Learning	Sajeena .S	241
80	Effectiveness of brain based learning on Achievement in Biology of Secondary School Students	Siji John	244
81	Brain Compatible Learning	A. Prabakar Devaraj	247
82	Brain - Based Learning in connection with Multiple Intelligence	Dr. R. Subburaman	250
83	New Way to Learn, New Way to Success: Brain-Based and Constructivist Learning Approaches	Sithara Vinod	253
84	Enriching classrooms through brain based learning.	Dr. C. Sivapragasam	256
85	Brain Based Learning in Science	Anil M. P	260
86	Brain-Based Teaching with reference to Adolescents	Muraleedharan T	261
87	How Brain Compatible Learning Environment helps in Learning	Sunny Raj A	264
88	Accommodating different learning styles through brain based learning	T. Golda Mayor	265
89	Role of Teachers in designing Brain Compatible Learning Environments	A. Sarlet	268
90	Brain -Based Learning	Prasida	271
91	Brain Based Learning as a determinant of Academic Performance in Struggling Learners	J. Mary Vasantham	272
92	Brain Imaging- The Natural Relationship between Brain Structure and Learning	P. Vel Murugan	275
93	Motivating Students using Brain based Learning Strategies.	Veena C.S.	277

V. Social Cognition: Neuro Scientific bases

95	Social Cognition: Grasping the Humanity	Dr. B. William Dharma Raja	282
96	Persuading Aspects of Culture in Social Cognition	Fathima Jaseena Bindu .T .V	286
97	Social Cognitive Learning in the Classrooms	Dr. Raghi. P. Nair	289
98	Classroom Practices Promoting Social Intelligence	R. R. Sheeja,	292
99	Cultural Intelligence for Understanding Cultural Diversity	V. Pravitha Dr. B. C. Sobha	295
100	Social Cognition-Neuroscientific Bases	Anusha .K .R	297

VI. Implications of Cognitive Neurosciences on Education

101	Attainment of Improved Cognition Through Mastery Learning Model	Dr. Malini. P. M	299
102	Cognitive Neuroscience: Implications for Education	Dr. K. Thiyaagu	302
103	Educational Implications of Cognitive Neuroscience	Vidhya V. S. Dr. Jaya Jaise	306
104	Cognitive Neuroscience Perspective for Mathematics Learning	J. Johnsi Priya	308
105	Cognitive Apprenticeship Approach in Educational Practices	V. Annet Joy	312
106	5f Model for Peer Tutoring in Mathematics at Secondary Level	Dr. Binu B.L.	315
107	Implications of Cognitive Neuroscience on Education	Geetha Rani T. Sajitha J. S. Emy Brindha T.	319
108	Implications Of Cognitive Neuroscience On Educational Practices	Gino D.J. A. Jothi	321
109	Effect of Nonviolent Communication Method on Assertion of Needs in Interpersonal Relationship. A Study among Iran Adults	Zohreh Ramezanipoor Dr. J. Jasseer	324
110	Critical Visual Literacy : A Neurolinguistic Approach to English Language Teaching	Dr. Jaya Jaise Shimna Suresh	328
111	Influence of Thinking Styles on Attainment of Integrated Process Skills in Physics of Higher Secondary School Students	Dr. Lavanya. M. P. S. Lenin	331
112	Cognitive Factors in Second Language Learning	M. Caroline Maria	334
113	Learning Styles of Prospective Teachers	Dr. S. Mani	337
114	Impact of Neuroscience on Higher Education	A. Evangelin Anusha N. Shiji	341
115	Role of Neuro-Endocrine System in Stress mediation	Mohanraj. S Periyasamy. P	343
116	Neurolinguistic Modeled VAK Learning Styles and English Language Teaching-Learning Process	A. John Lawrence Dr. C. Bright	345
117	Cognitive Neuroscience on Education	Dr. K. Dhanalakshmi R. Raj Kumar	347
118	Implications of Cognitive Neuroscience on Education	C. Rajeshwari E. Jeyasutha T. Selvakani E. Sree Vaisnava Devi	351

119	Integration of Cognitive Neuroscience in Education with Special Reference to Secondary School Students	Rajeswari K. C. J. Kirupa Kani	354
120	Music - An Effective Means to Reduce Test Anxiety	Dr. B. William Dharma Raja Dr. R. Ramkumar	357
121	Neuroscience – A Key to change classroom environment	P. Jeya Puvaneswari	360
122	Developmental Cognitive Neuroscience of Arithmetic: Implications for Learning and Education	Y. A. Shiny	363

VII. Affective Neuroscience

123	Affective Neuroscience –Paradigm for Developing Emotional Competencies in Learners	Dr. Bindu.R.L	366
124	Sensitizing the Adolescents About the Problems of Aged : An Affective Neuroscientific Perspective	Dr. P. Rekha Dr. K. Vijayakumari	373
125	Effectiveness of Value Discussion Model on the Affective Domain Competencies of Adolescents	Anitha. G Dr. Celine Pereira	376
126	The Role of Affective Neuroscience in developing Emotional Competencies	Karthika A . R Sreeja . T Devika. S Dr.Asha. J.V	380
127	Enhancing Emotional Intelligence in Children: The Need of the Hour	Jisha GR	385
128	Affective Neuroscience and Learning	N.J. Ajitha A. Emmaculin Anulet Dr. A. Beaula	389
129	Neural Impulse Propagation through Excitatory and Inhibitory Post Synaptic Potential in developing Emotional Competence	Dr. Madhubala S.	391
130	A Study on Emotional Intelligence of Prospective Teachers	T. Sachutha Prasad. P.S	395
131	Combining Emotion and Cognition	K. Sheeba, Dr. N. Kalai Arasi	397
132	Developing Emotional Competencies in Students – The Commitment of School Teachers	J. Angel Mary Jane Dr. S. Praveen Kumar	401
133	Developing Emotional Competencies in Teachers	M. Josephin Bella E. Johncy Manjula	404
134	Instilling and Developing Emotional Competence Strategies and Culture in Teaching – Learning	Jyotsna P Dr. Nimmi Maria Oommen	406
135	Impact of Epilepsy on emotions of children	Dr. Renuka Sonny .L.R	410

VIII. Computational Neuroscience & Neuro Informatics

136	Computational Neuroscience	Shyla T	415
137	Computational Neuroscience	Suji N.	418
138	Neuro Informatics	V. P. Bindu Gouri. Vinitha K. Kanimozhi M.	421

How the Brain Learns Mathematics

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Abstract

Hemisphere specialization of the brain has two hemispheres: the left hemisphere specialized for logico-analytic tasks and the right hemisphere, visuo-spatial tasks. Teaching is based on left brain strategies which favour left brain dominators. Mathematical intelligence is questionable grouping. The functions of the hemispheric part for: understanding the question – occipital lobe functions; identifying the requirement of mathematics which is higher order thinking – frontal lobe and memory area of the brain function; and writing what in question involves left brain. Brain activation while solving algebraic problem, geometric problem and spatial reasoning is interior parietal cortex, the prefrontal cortex and anterior cingulated; left parietal cortex and right prefrontal cortex; and parietal cortex respectively. Exercise required for left brain is word usage and logical reasoning. Implications in education with regards to curriculum, instruction and assessment in mathematics can be changed as the functioning of whole brain.

Introduction

Functional understanding of the human brain is an ongoing challenge for neuroscience. The human brain has the same general structure as the brains of other mammals, but has a more developed cerebral cortex. The cerebral cortex is nearly symmetrical with left and right hemispheres. Left hemisphere dominate reading, speaking, analytical reasoning and arithmetic. Right hemisphere is better for spatial tasks like drawing a figure and recognizing a face (Wheatley Grayson H., Mitcheal Robert, 1978). Each hemisphere is conventionally divided into four “lobes”, the frontal lobe, parietal lobe, occipital lobe, and temporal lobe. The main functions of the frontal lobe are to control attention, abstract thinking, behavior, problem solving tasks, and physical reactions and personality. The parietal lobe, for example, contains areas involved in somato sensation, hearing, language, attention, and spatial cognition. The occipital lobe is the smallest lobe; its main functions are visual reception, visual-spatial processing, movement, and color recognition. The temporal lobe controls auditory and visual memories, language, and some hearing and speech. Classroom teaching styles use left brain strategies. This favor left brain dominant students, and is difficult for right brain dominant students.

Left hemisphere

Left brain students are good at linear and sequential processing, such as language and math, symbolic language and can easily memorize vocabulary or math formulas and also good at

planning and following directions. These students easily learn information in lecture-style and teaching approach. These students can easily express themselves in words. Left brain students are better at writing and spelling, since it involves sequencing and organizing of letters and words. This is a large part in class participation and in assignments.

Left brain students are good note takers and list makers. They are also good at planning and scheduling. This means they are good at completing assignments.

Right hemisphere

Right brain students process information more holistically. They learn by understanding the big-picture, not the details. They tend to be visual, not language oriented. This means they have more difficulty following a lecture-style teaching approach. Right brain students can benefit from reviewing material before class to understand the bigger picture, and to understand the context for details that will be taught in class. These students know what they want to say, but often have trouble finding the right words. A right brain student needs to see, feel, or touch the real object. Right brain students tend to approach things randomly. They tend to jump around from one task to another without regard to priorities.

They prefer hands-on activities, and need to draw out a math or other problem to understand it. They also need diagrams or illustrations to help visualize the problem or solution. Right brain students learn visually, not by listening to a lecture-style class.

They must take extensive notes, and use diagrams and drawings to make information more visual, to facilitate learning the information. They also need to make mental images of things they hear or read in order to remember the information.

Right brain students may be late with an assignment, not because they weren't working hard, but because they were working on a lower priority assignment. Right brain students need extra effort in reading instructions to understand the assignment.

Right brain students require more time to write a paper, and require more revisions to remember what they learn. Right brain students must also rely more on spelling checkers and proof reading for their assignments. Right brain students tend to be more creative, but have more trouble than left brain students with the mechanics of writing and communicating.

Role of Learning Hemispheres in mathematics

The logical-mathematical intelligence seems a questionable grouping. Arithmetic is often associated with the left brain sequential processing, yet there is good evidence that mathematically gifted children tend to be left handed implying right-brain dominance.

Identifying the math required

The problem may involve algebra or trigonometry or logarithms or differentiation or perhaps integration. This is where one is in the need to actually **learn** the formulas. This step uses the higher-order thinking areas at the front of the brain which is the frontal lobes and the memory areas of the brain (Murray Bourne, 2008).

Writing down or drawing what the question tells

By listing the information in a question, it helps to shift through what already known and it reminds you of the math that might be involved. Now left brain is involved in the writing part, which is above left ear.

If there is any geometry involved (or graphs, or moving objects, or any other visual element) in the question, the parietal lobes, the sensorimotor region and the vision are used (Murray Bourne, 2008).

Algebra and the Brain

While solving algebraic equations brain activates the inferior parietal cortex, the prefrontal cortex, and the anterior cingulate.

Geometry and the Brain

While using geometry are the areas of the brain which are the most responsive are the left parietal and right prefrontal cortices, the same areas involved in arithmetic and algebraic problem solving

Spatial Reasoning in Mathematics

The frontal cortex, however, is not the only brain region which contributes to the integration of information processing, especially with high cognitive challenge. The parietal cortex is especially involved in spatial perception and spatial working

Left brain exercises

Exercises required for left brain are word usage and logical reasoning. Brain teasers or word puzzles are examples which strengthen its function. Spelling and Mathematics activities are also good. Basically any task or test involves deductive reasoning, working through a problem in sequential order, or working with distinct facts and figures will enhance the functioning of left hemisphere.

Implications

Curriculum:

In order to be 'whole brained' in their orientation, school need to give equal weight to the art, creativity, skills of imagination and synthesis (Bernice McCarthy, 2011).

Instruction:

To foster a more whole – brained, teachers should use instruction techniques that connect with both sides of the brain (Bernice McCarthy, 2011).

Assessment:

For more accurate whole brained evaluation of student learning, educators must develop new forms of assessment that honor right brained talents and skills (Bernice McCarthy, 2011).

Conclusion:

Poor performance in problem solving and higher ordered thinking may result in part, from an emphasis on left hemisphere tasks. The left hemisphere is specialized for computation. Deficits in the posterior parietal cortex are classically thought

to underlie dyscalculia, a disorder of numerical competence and arithmetic skill, which is manifested in individual of normal intelligence. Attention is also important for doing math problem. Attention is

focused upon four constructs—cognitive ability, laterality, functional brain asymmetry, and structural brain asymmetry—and the associations among them

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