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Intentionality, Pygmalion, and Cognitive Fun Redirects Elementary School Children in Pull-Out Neural Enrichment

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ABSTRACT
This study describes an academic enrichment intervention for 15 'high risk' children who were pulled out of General Education classrooms in Bangalore India for 40 minutes four-times a week during a typical school year. Could a brain-based intervention reduce achievement gaps that showed up for these children in terms of below-grade academic outcomes and impoverished social and emotional wellbeing? The null hypothesis stated that a teacher's mental model that shifted to brain-based methodology would have no perceivable effect on (i) children's academic achievement or (ii) their social and emotional engagement. This study was grounded in teacher education literature involving mental models that illuminate classroom management techniques. Subjects were drawn from second grade students (mean 6.7 years; n = 15). Study was an opportunistic quasi-experimental design reflecting school life across India. Qualitative ethnographic data using grounded theory were triangulated with quantitative measures that best account for observed outcomes. Findings highlight significant academic, and social and emotional growth, which dramatically reduced the achievement gap for all participants.
keywords: Intrinsic, brain-based, emotional maturity, mixed method, self-regulation

1. Introduction

Teacher training is critical. The purpose of this study is to highlight that teacher training *per se* is not sufficient for achieving the lofty goals set in motion by educational systems everywhere. Teacher's mental models because of the kind of pre- and in-service training makes all the difference. Their deep understanding of whom they are and what they are doing sets in motion an intentionality for classroom management, engaging lesson plans, and student outcomes (Richards & Pennington, 1998). Pre-service training helps codify a teaching 'mindset' that propels knowledge and skills into every realm of methodology, affects every process, and touches every practice (Darling-Hammond, 2019). Here, we describe two elements of teacher training that illuminate the reasons why some children succeed while others fail (Barbaro & Goldstein, 2019).

The significance of this perspective over the prevailing entrenched thinking that unremittingly causes our school systems to be serviced by educators whose woeful lack of understanding about how the human brain works and how children learn makes for an especially damming assessment of teacher preparation.

Researchers point to a covert subjectivity that accompanies pre-service novices (Lortie, 1975) and prevents them from accessing mental models, which have been shown to deliver better

outcomes (O'Mahony & Veeranna, 2023). Secondly, we highlight Rosenthal & Jacobson's (1968) pivotal description of learning spaces regarding teacher 'affect' that predicts implicit mindset and delivers tacit unstated beliefs.

1.1. Apprenticeship of Observation

Researchers describe an *apprenticeship of observation*[1] phenomenon (Lortie, 1975), which tends to limit how novice teachers perceive their roles in classrooms. Most arrive at teacher training courses with experiences that color their understanding of what it means to be a teacher. For instance, having spent thousands of hours as schoolchildren observing and evaluating other teachers in action, they supposedly understand how learning happens. This rarely occurs in other professions. Children do not typically spend thousands of hours observing lawyers, nurses, or aerospace engineers at work. One of the consequences of this apprenticeship period is that, whereas people entering other professions are more likely to be aware of the limitations of their knowledge, student teachers may fail to realize that the aspects of teaching which they perceived as students represented only a partial view of the teacher's job.

For this reason, teaching behaviors are rarely analyzed; they remain intuitive and imitative. For the majority of teachers, methods can be seen as 'ready-made recipes for action and interpretation that do not require testing or analysis while promising familiar, safe results' (Buchmann, 1987). This model provides student teachers with 'default options', a set of what they consider to be tried and tested strategies which they can revert to in times of indecision (Tomlinson, 1999).

This partial understanding of what it means to be a teacher tends to set up an 'interpersonal expectancy situation referred to as the Pygmalion or Golem Effect. "The bottom line is that if we expect certain behaviors from people, we treat them differently" (Rosenthal, 1968).

1.2. Pygmalion/Golem Effect

The Pygmalion Effect in the classroom describes a phenomenon whereby higher expectations lead to increased performance. Rosenthal's description is as meaningful today as it was 60 years ago (Rosenthal & Jacobson, 1968), since implicit bias (Kahneman, 2011) pervades teachers' lived experience. A corollary of the Pygmalion Effect is the Golem Effect, in which low expectations lead to a decrease in performance. Both effects can appear as self-fulfilling prophecies.

Classrooms designed with brain-based methodologies in mind are very different to traditional classrooms that represent Lortie and/or Rosenthal's unconscious designs (Gallagher, 2024). In a traditional setting, lessons are focused on academic outcomes based on content that is measured using high stakes assessment tools. It is rare to hear teachers discussing or planning to architect a child's brain (Coyle, 2009). For instance, embodied cognition in lesson plans that include kinesthetic activations and, which focus on growing white matter structures pertaining to focus and attention (Ratey, 2008), looks very different from planning sessions for 'content' lessons (Medvedich, 2024; Willis, 2011). Most teachers inherited a fixed mindset by sheer dint of long years in immersive observation (Willis, 2006). By contrast, Neural Enrichment educators portray embodied cognitive thinking—it's not about content; it's about architecting children's learning brains (O'Mahony, 2021).

[1] *Apprenticeship of Observation* was a term coined by Dan Lortie in his book, *Schoolteacher: A Sociological Study* (1975) which describes an atypical model of learning that was largely responsible for preconceptions and misconceptions that pre-service student teachers imagine about teaching.

In this study, new training shifted the teacher's[2] thinking in relation to brain and learning (Medvedich, 2024). The research team sought to understand this newfound intentionality and mindset. Beginning of year tests highlighted serious deficiencies in reading and writing for the children who were seen as high-risk of failing—literacy skills that were essential for success in school (McCandliss, 2023; McEwen, 2009) and needed in order to advance to third grade. These dire results align with a corpus of educational literature that documents grave outcomes for life trajectories because of high-risk children's impoverished opportunity through increased achievement gaps (Gershoff & Font, 2016; Murphy et al., 2019). Such opportunity gaps are apparent with factors like race, gender, ethnicity, socioeconomic status, and English Language proficiency contribute to lower educational accomplishment (Bracey, 2006). In this study, other factors were also at play. These included poor parental education and home life stresses caused by lack of proficiency with English language (Abadzi, 2006; Trummert, 2016), as well as issues that sprang from the COVID-19 pandemic (Guariso & Nyquist, 2023; Milman, 2020) and included isolation, masking, and social distancing.

Ms. P's success was bolstered by existing ongoing educational experiments about which she was aware. Educators in the US had documented similar classroom sized, individual and group improvements that looked similar, through poverty (Medvedich, 2024), behavior (Gallagher, 2024), opportunity (Hylton, 2024), and achievement (Donati, 2024). The children in this study were first participants of a novel teaching methodology in India emphasizing a brain-based pedagogic model.

1.3. Theoretical Framework

The overarching theoretical framework for this study introduces a paradigm shift on three planes with constructs that are typically familiar to teachers—if only in one dimension. These constructs serve to provide a foundational context with cognitive neuroscience theories that underpin the research study. For instance, while most educators are very familiar with *Theory of Mind* (Brown, 2007) and, in particular, *Mindset* (Dweck, 2006), it is unusual that they come to understand the significance of these constructs through a neural lens (O'Mahony et al., 2024).

It is common for teachers to view themselves as *Growth Mindset* because it sounds more appropriate in their profession than *Fixed Mindset*. The second construct focuses also on a continuum where teachers are mostly under the misapprehension that they are *Adaptive* rather than *Routine* in their application of expertise (Hatano, 2005; Hatano & Inagaki, 1986). And for motivation, given the choice of *Intrinsic* over *Extrinsic* (Pink, 2009) teachers will typically gravitate towards Intrinsic—even when they have poorly understood implementation events. Thus, teachers' desire to be intrinsic are often more aspirational than real. When a neural focus on professional development highlights a nuanced shift along these three planes (O'Mahony et al., 2012), teachers experience an ignition that propels them to an innovative mentalistic conviction that can ignite careers.

An informed approach to lesson planning, implementation, and classroom management when viewed through these three lenses—Mindset, Expertise, and Motivation—results in a totally different engagement, and a very welcome outcome for learning with deep understanding and critical thinking.

[2] The teacher in question is referred to as Ms. P. This is not her real name. She had recently consumed a one-week professional development training course that she described as 'life changing' for her own children as well as the children in the school where she was working.

2. Research Question

"Would a teacher's mindset, which instigated a cognitive mental model, eliminate achievement gaps for seven-year-old children?" This question was operationalized in these two constructs: Can a Neural Enrichment program improve (i) academic scores for children across all subjects, and (ii) improve children's social/emotional engagement?

3. Methodology

When children are not able to engage in learning systems that are age-appropriate and necessary for them to move up to the next grade level it is usual to use special interventions to shore up gaps and to support struggling individuals. In Bangalore during Covid, there was the usual isolation, social distancing and quarantine that wreaked havoc on the educational system (Jeffers et al., 2022; Milman, 2020).

3.1. Population, Sample, and Sampling Technique

The study took place within an elementary school in Bangalore, India. Second grade total population included 122 children, of which, fifteen were chosen for this study because they failed a test designed to show readiness for second grade challenges. Of this small group, most could not read, some could not write, and others were reticent to talk to peers or adults. These children were entering school for the first time in second grade—a product of the Covid-19 pandemic pressure that schools and families were put under for at least two years.

The fifteen children who were mostly non-verbal, showing symptoms of high anxiety and failing simple reading and writing tests were pulled out of class and taken to a room across campus, which became the *Neural Enrichment* intervention. Table 1: *Pre and Post Neural Enrichment 2nd Grade Summary* shows scores for the fifteen children (names protected) pulled from four second grade classrooms (*Faith, Gratitude, Praise, Respect*). These scores supported the selection of weakest performers in the academic subject areas English, Mathematics, Environmental Science, Computer Skills, and two languages – local Kannada, and national Hindi. (Note: P stands for Periodical Tests. P1 Eng refers to the first test in English; P4 Eng refers to the final test in English.)

Table 1.
Pre and Post Neural Enrichment 2nd Grade Summary

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	ID	Age	Gender	P 1 Eng	P 1 Math	P 1 EVS	P 1 Comp	P 1 Kan	P 1 Hin	P 4 Eng	P 4 Math	P 4 EVS	P 4 Comp	P 4 Kan	P 4 Hin	P 1 Total	P 4 Total
2	Faith 1	7	1	38	26	43	45	50	15	75	78	68	78	83	78	36.17	76.67
3	Faith 2	7	2	20	10	20	30	40	10	20	48	33	45	25	33	21.67	34.00
4	Gratitude 1	6	2	30	18	33	55	20	10	33	55	63	68	68	30	27.67	52.83
5	Gratitude 2	7	2	20	33	30	70	53	33	45	85	70	78	93	80	39.83	75.17
6	Gratitude 3	6	1	30	10	20	30	25	10	28	43	50	60	60	13	20.83	42.33
7	Praise 1	6	2	19	30	50	50	58	10	70	55	58	70	88	65	36.17	67.67
8	Praise 2	7	1	30	33	38	78	33	0	83	68	75	85	60	30	35.33	66.83
9	Praise 3	6	1	34	33	33	50	58	18	54	50	70	68	80	68	37.67	65.00
10	Praise 4	6	2	16	48	18	45	35	0	54	53	55	65	58	55	27.00	56.67
11	Praise 5	7	2	10	8	18	40	53	0	49	0	53	78	53	0	21.50	38.83
12	Praise 6	7	2	13	23	30	80	35	0	54	58	70	85	80	48	30.17	65.83
13	Respect 1	6	1	25	43	40	55	53	0	51	90	68	58	83	70	36.00	70.00
14	Respect 2	6	2	58	68	60	65	73	20	65	90	78	85	85	50	57.33	75.50
15	Respect 3	6	1	50	63	48	58	65	35	61	70	83	80	75	55	53.17	70.67
16	Respect 4	7	1	48	43	63	55	68	25	35	83	63	68	78	55	50.33	63.67
17																	
18			Mean	29.40	32.60	36.27	53.73	47.93	12.40	51.80	61.73	63.80	71.40	71.27	48.67		
19			Mediar	30	33	33	55	53	10	54	58	68	70	78	55		
20			Mode	30	33	20	55	53	0	54	55	70	78	83	55		
21																	
22			Min	10	8	18	30	20	0	20	0	33	45	25	0		
23			Max	58	68	63	80	73	35	83	90	83	85	93	80		
24			Range	48	60	45	50	53	35	63	90	50	40	68	80		
25																	
26			Vari	200.97	329.54	211.64	227.78	252.35	141.54	313.17	545.21	158.17	131.69	310.21	545.95		
27			St Dev	14.18	18.15	14.55	15.09	15.89	11.90	17.70	23.35	12.58	11.48	17.61	23.37		

Data were collected weekly via age-appropriate school-wide testing instruments that are commonly used to test subject comprehension in elementary schools in Bangalore. Ms. P used Excel charts to manage student scores, which allowed her to focus attention on these children who had fallen behind academically. It was clear to the teaching staff that the children who were lagging were doing so because they lacked the skills in English language to keep up with children who already had solid foundations in that arena.

As soon as she had instantiated a safe psychological environment in the pull-out room, she set about supporting these children at gaining a meaningful aptitude for learning. This pull-out room had no windows and no furniture—the children sat on mats on the floor. Each child was given a pencil and paper with which to practice writing while engaging in reading and comprehension exercises in the English language. Neither was there any access to modern technology—just a green board and chalk. This was partly by design—back to basics—and partly opportunistic, since it was the only empty space available.

Ms. P was intentional about achieving each child's innate potential. She delivered lessons that leaned on her conviction that a cognitive growth mindset would prevail—she understood that both 'Talent' and 'Intelligence' were malleable and easily increased in 2nd grade children. Likewise, she was intentional about immersing the children in activities within an intrinsic motivation model by giving them opportunities to experience *Autonomy* (sit on this mat or that mat), with immediate outcomes of *Mastery*. She was quick to 'make visible' children's easy access to *Purpose* (I am good at reading new words). She was aware that her new terminologies were not the usual vocabularies that are used in typical Bangalore 2nd grade classrooms.

Each week Ms. P captured recordings of these active lesson implementations. Videos were transcribed in English. Lessons was designed under the principle of *Adaptive Expertise* (Lin et al., 2005) by focusing every day on learning opportunities that were grounded in kinaesthetic movement (Botha & Africa, 2020) and included joyful fun (Seligman, 2012). She welcomed the children and invited them to be willing to take risks with new words and concepts; to step

outside their comfort zones; to be vulnerable and share feelings with ease about challenges in front of peers. In this daily experiment she modelled a 'tolerance for ambiguity' (Bransford et al., 2000; Panksepp, 2011) designed to help children thrive in a social and emotional safe space.

Her focus was on cognitive methods, which she believed would support the children by architecting their brains. She used the *Challenge Mosaic* pedagogic model (O'Mahony et al., 2012) to introduce teaching practices like *long term potentiation* (Bliss & Lomo, 1973), play in the *uncinate fasciculus* (Medicine & Stanford, 2023), and strived to reach children's *supramarginal gyri* (Ramachandran, 2012). She was easily able to engage the children with word play in the *phonological loop* (McCandliss, 2023), practice in the metaphor (angular gyrus) zone (Ramachandran, 2012), rehearse skills like altruism and empathy so that in a short time the children showed signs of intelligent and abstract thinking together with smart problem solving.

Ms. P was aware that while she was teaching the children grammar and fluency in the English language, she was also establishing and myelinating white matter structures in areas of the brain that could also be used for subjects like Mathematics, and Computer Science, for social engagement with peers and intelligent interactions with teachers.

3.2. Mixed Methods

The research team adopted a nested concurrent research design to highlight strengths of this learning sciences study (Creswell & Creswell, 2022). It combines qualitative and quantitative data collection and analysis as shown by the high-level schematic (Salmona et al., 2020) in Figure 1. It depicts the two types of data represented in this mixed method study. Quantitative data relating to attendance, gender, age, and pre- and post-scores detailing literacy values are embedded within a qualitative corpus of interviews, video transcripts, work samples, photographs, and field notes.

The research team was distributed across states and countries. We chose a coding software platform (Dedoose 2024), which facilitated focused and safe communication channels while data (e.g., transcripts, audio files etc.) were processed, coded and analyzed. The team began with an axial coding review, that 'made visible' connections between related codes (Strauss & Corbin, 1997). When patterns and programmatic outcomes emerged, team members switched to selective coding techniques and focused on categories that alerted theoretical deduction.

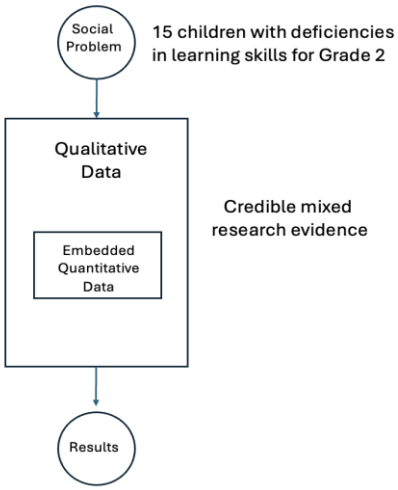


Figure 1. Mixed Method Model
Source: Dedoose 2024, Bangalore Elementary School Dataset

Files were transcribed inhouse and validated with Ms. P for sanity and rigor. Building off the theoretical Framework a code book was created that defined categories and associated codes. Weights were assigned to codes based on a tripartite division—codes that were neutral were assigned the number zero; codes that indicated growth were assigned +1; codes that indicated a negative outcome were assigned -1. An example entry in the Code Book is shown in Figure 2.

Theme	Sub-Theme	Code	Code Name	Abbrev	Code Definition	Code Description
Mindset	Behaviorist		Behaviorist Lens	BL	Skinner	Teaching methodology that is influenced heavily by Skinner thinking.
			Defensive	Def	Being on Guard	When a child reacts because s/he is frightened or uspet.
			Reactive	React	Involuntary	An involuntary reaction to stimulus that typically causes the child to avoid engagement.

Figure 2. Code Book Example for Mixed Methods
Source: Dedoose 2024, Bangalore Elementary School Dataset

Coders divided field notes and transcripts equally after training. All data were imported into Dedoose. Interrater Reliability was calculated within the Dedoose program. Cohen's Kappa was 0.86. Expected agreement was 0.75, because all coders joined the project around the same time and trained together.

3.3. Grounded Theory

Grounded theory (Cohen et al., 2016) was used to explain apparent changes over time and involved both inductive and deductive ideations. This methodology offered sense-making measures to protect the integrity of the data, teaching methods, and personal views of teachers and parents. Daily team discussions ensured that interpretation was valid and reliable. These discussions were designed to address biases, prejudices, and stereotypical perspectives that tend to creep in subjective analytic processes (Shulman, 1998). Theoretical explanations were grounded in empirical reality to reflect relatable and valid data (Corbin & Strauss, 2015).

4. Results

This Neural Enrichment program took place in an inner-city elementary school in Bangalore India. Research questions focused on (i) academic achievement, and (ii) social and emotional engagement resulting from one teacher's cognitive training. The unit of analysis was 'teaching method' as it related to motivation, engagement, and outcomes. In a mixed method design, we highlight findings from quantitative and qualitative data.

4.1. Academic Achievement

Ms. P's focus for the pull-out intervention was to improve English language competence. It was no surprise then, that all children did improve significantly in English language reading and writing as shown in Figure 4.

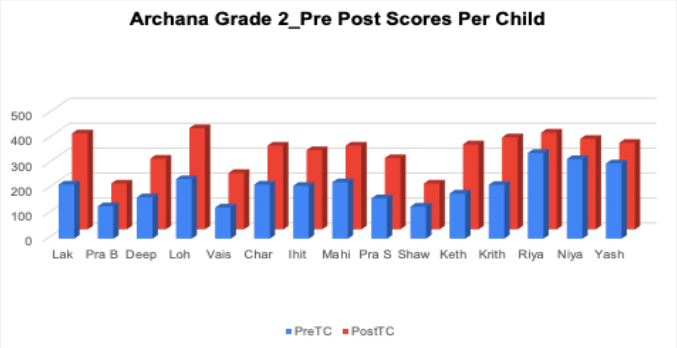


Figure 4. Neural Enrichment Pre-Post English Language by Student
Source: Neural Enrichment Study 2021-22, Bangalore India.

The newfound competency in English language transferred quickly to other learning areas. Results showed a significant improvement in Mathematics, Science and other subjects that were taught through the medium of English, as shown in Figure 5. This notion of 'far-transfer' (Bransford & Schwartz, 1999) was critical for student success for advancement to third grade.

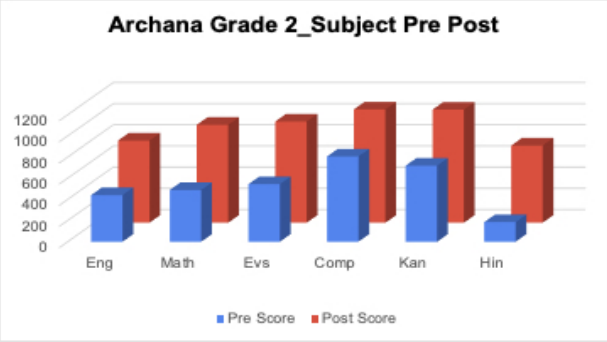


Figure 5. Neural Enrichment Pre-Post All Subjects

For academic subjects, a paired t-test was performed comparing 'before' and 'after' test scores. Because of the small sample size, we adjusted significance level and power to substantiate statistical credibility (de Winter, 2013).

Significance levels were interpreted at 0.15, and statistical power lessened to 0.75. Pre- and post-intervention scores are highlighted in Table 2: *Statistical Analysis Neural Enrichment 2nd Grade*. These consist of test averages, T-statistics, and P-values for paired t-tests across each academic subject and on total test scores.

Table 2:
Statistical Analysis Neural Enrichment 2nd Grade

Subject	Pre-Test Average	Post-Test Average	T-statistic	P-Value
English	29.400	51.800	-4.208	0.001
Math	32.600	61.733	-6.384	0.000
EVS	32.267	63.800	-8.602	0.000
Computer	53.733	71.400	-6.679	0.000
Kannada	47.933	71.267	-5.225	0.000
Hindi	12.400	48.667	-6.653	0.000
Total	35.389	61.444	-11.347	0.000

We rejected the null hypothesis to confirm that indeed, a cognitive neuroscience professional development for one teacher could (and did) affect a positive improvement in (i) academic outcomes and (ii) social and emotional wellbeing for children in 2nd grade. All children significantly increased their academic scores in subjects including Mathematics, Environmental Science, Computer skills, and in the two languages Kannada, and Hindi.

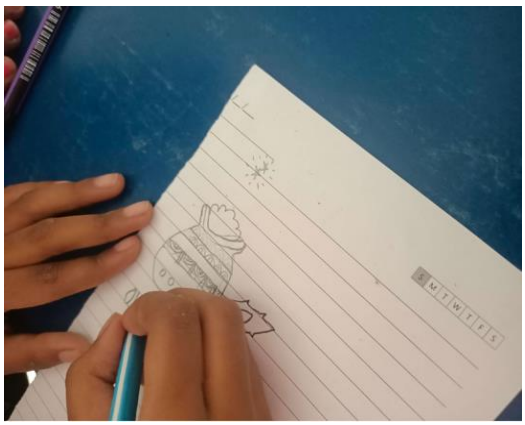
4.2. Social and Emotional Growth

At the outset of the neural enrichment program, it was clear that some children couldn't read. Here is how Ms. P described one child's plight. "She just point blank told me that… 'I can't read'". (Dedoose: *2_Archana Data 20230928_Pt.1*)

Other children couldn't write, and still others couldn't or wouldn't talk to peers or grown-ups. Ms. P was convinced that each child had potential for academic and social success. She was also convinced that traditional classroom routines were not able to engage that potential. This intentionality shone through from the beginning.

She was willing to experiment with one of the primary constructs that she had learned in the earlier cognitive training—that of fun with language acquisition as children were encouraged to 'play in the phonological loop' (McCandliss, 2023). She set about analyzing components of the cognitive pedagogic model to test these new theories. The first adjustment that she chose to make was grounded in an idea, which stated that intrinsic motivation was paramount for children who struggle in school (O'Mahony & Veeranna, 2023). This meant that she would have to jettison earlier training in relation to discipline that involved rewards and punishments.

In the following segment, Ms. P manages to engage a young scholar who hadn't opened her bag or muttered a word since coming to school three months earlier. In response to a question the child remained silent. Her friend answered for her…



[Dedoose_Code_Excerpt: Ih_00:17:28_Ki_20241003]
Figure 6. Neural Enrichment Student Sample Work

4.2.1. Excerpt Highlights Ms. P's determination

15. "Ma'am, she doesn't talk."
16. "Do you like drawing?" She didn't respond… no nod… nothing.
17. "Do you have a pencil?" She did not say anything.
18. Her friend said, "Ma'am, she has a compass box. It's there in her desk."
19. "Take whichever pencil you want."
20. She took a pencil; she took her eraser in her left hand, and then she drew.
21. The other children have been drawing for, uh, two periods for that activity.
22. She drew it very fast, and she finished it, <laugh>, in two minutes…

This student's peers were convinced that she didn't speak (line 15). In 2 minutes, this young girl copied a drawing from the green board—a task that the other children took 2 periods to complete (Lines 20-22). Astonished, Ms. P vindicated in her thinking, resolved to dig deeper. This early success increased her resolve to experiment further with methods that she had learned in the online training. Success was to be accomplished in a psychologically safe place. She implemented a teaching philosophy firmly rooted in the belief that all children wanted to learn. If they were not experiencing success, it was up to her to adjust the learning environment so that they could thrive.

She first introduced movement. This generated excitement by eliminating anxiety and boredom. Each new teaching tool was designed so that children could experience joy while learning / practicing new skills and knowledge. Examples are documented in video data that showed the children: (i) jumping over a rope that was laid on the floor to help predict masculine vs. feminine words, (ii) hopping on one leg to build words with letters that were scattered on the floor, (iii) peeping though a makeshift 'hole in the wall' to understand the feeling of 'longing' to see flowers in the Giant's garden. Her desire to implement Pygmalion turned into reality while students she believed were capable of learning proved her right (Snow et al., 1991).

4.2.2. Ms. P's Clever Mentalistic Metaphor

Ms. P's most intriguing brainchild was an ingenious fusion of intentionality, Pygmalion, and cognitive fun. Realizing that learners can be trapped by limitations of working memory, she invented a clever mentalistic metaphor that transformed their ability to gain reading fluency by using internal monologue and visualization. The problem, she judged was with decoding skills—the children could recognize phonemes and read words, but there was limited bandwidth for comprehension. "They could not connect the dots…" Ms. P pointed out (M.doc_Arcchana (00:52:18). Her solution was simple yet elegant.

9. Whenever you are reading any lesson, make a movie out of it…
10. …it becomes much more easier (sic) to run through it,
11. … rewind it, fast forward it during your questions… who said what to whom?
12. … because kids are more, uh, they can relate to mobiles …, YouTube.
13. So, I told them it's like YouTube.
14. Only … make it a MeTube.

The children loved the idea of a 'MeTube' that made the stories they were reading in the text come to life. They loved her class so much that she had to ask them to not advertise it during recess in the playground. "Keep it a secret!" she advised. Soon, all the children in Gen Ed wanted to join the intervention cohort.

1. By October, I had other students telling me, ma'am, we also want to come to your class…
2. They sensed that (we) were having much more fun in the (Neural Enrichment) classroom than what they were having (in Gen Ed).
3. … these children used to jump out of their chairs to come out (to Neural Enrichment).
4. Also, if I go to (just visit) their classrooms, they used to feel that I've come to take them (to Neural Enrichment). So, they jump out of their desks, and they line up in front.
5. A teacher's daughter. She used to come to me in school. Ma'am, can you take me also in your class.
6. …I told the children… "It is a secret; you don't have to go and tell the other kids."
7. But how many days will children keep a secret?
8. So, they told them… "We are getting balls; we're playing with the balls. We played this, we played that. We have gift boxes, ropes, games."

Ms. P: (Lk.doc_Arcchana (00:12:45)

Gone was the stigma of remedial catch-up labeling. Fun was fun and children were happily learning.

5. Limitations

It should be noted, that although these results showed significant improvement in scores across all subjects, the adjustments needed in the thresholds raise some concerns regarding the robustness of these findings. The reduced statistical power and elevated significance level will increase the likelihood of Type II errors - failing to identify real effects of the neural enrichment intervention. The findings, while promising, highlight the need for further studies with larger sample sizes to establish more definitive and reliable results.

Though this study is limited by its small sample size, given the importance of the question and its widespread implications for elementary and middle school children, we recommend that it be viewed as a proof-of-concept study that illuminates possibilities highlighted by investigating learning spaces via a neural lens. It was only a short lifetime ago that this arena for study was treated as a bridge too far (Bruer, 1997). There is strong evidence that the decade of the brain contributed to public awareness in relation to possibilities that affect society as a result of an outpouring of new and emergent knowledge (Jones & Mendell, 1999). In areas of mental health, education and suicidality there is a growing realization that solutions are being found in new scientific approaches to education (Ben-Hur, 2006; Bhattacharjee, 2012), social and emotional learning (Bogni et al., 2020), and mental wellness (Boyce, 2016; Munsey, 2010).

It is feasible that the study sample in an elementary school in Bangalore accurately mirrors populations in similar cities across India. There are, however, questions pertaining to culture and geography that prohibit generalizability to schools in say, southern California or northern Sweden. There is a cognitive question that might be more meaningful for future studies. Are these potential confounding factors persistent or are they only confounding in a traditional model that seeks to manage behavior through Skinnerian models rather than focusing on methods that are designed to architect a learning brain? Neural diversity in a school population in Bangalore probably mirrors neural diversity in school populations anywhere. When viewed through a neural lens teachers focus on white matter structures that underpin cognition and deep understanding. In other words, brain is brain—whether in Bangalore or Sweden. These are questions that more research might answer soon.

6. Conclusions

By any measure, this study was an unusual one. The small n (15), though problematic, was however, real. It represented typical classroom challenges and practices in elementary schools across India. This study described a cohort of children who were ‘pull-out’ participants in an innovative neural enrichment intervention that sought to eliminate opportunity and/or achievement gaps for 2nd graders. The teacher, who had recently been trained in a neural ‘cognitive’ methodology opted to focus on literacy in English language. She also abandoned all ‘tried and tested’ behaviorist methods from her years of experience implementing a rewards / punishment approach to discipline. Instead, she opted to implement new methods in cognitive brain-based design.

COVID played a large part in school crises. Having entered elementary school after a two-year online hiatus, some children were unable to read, write, or articulate their thoughts to peers or grown-ups. Parents and teachers agreed that they had been negatively impacted by masks, isolation, social distancing, and quarantine. The question was, “could a teacher’s brain-based mental model reverse the trajectory for these 15 children and propel them to succeed in school?

Findings highlight teacher intentionality in architecting children's brains through use of a brain-based pedagogic model was successful at impacting learning outcomes and related life skills?

From a paradigm-shifting perspective (cognitivism over behaviorism), Ms. P had been invited to reframe her mindset regarding solutions for disruptive behaviors. She adapted her traditional extrinsic rewards/punishments stance (Hennessey, 2000), to an intrinsic approach established on a nuanced definition that privileged autonomy, and mastery and lead to purpose (Boyce, 2016; Pink, 2009). Neuroscience (Ramachandran, 2012) points out that behavior is simply communication—that all behavior has a neural substrate and that teachers can look for neural substrates to solve unexpected behavior.

Ms. P was trained to think in terms of neurotransmitters instead of grades; dopamine instead of amygdala hijack (Sapolski, 2018). She abandoned public-shaming practices like 'clipping', and class dojo—electronic modalities that tend to pinpoint children's behavior in either a positive or negative way on very visible boards (Singer, 2014). Finally, and probably most providentially, she was introduced to new information that is widely available since the 'decade of the brain' (Johansen-Berg & Duzel, 2016), and includes salient understandings about how genetics and epigenetics impacts the learning brain (McEwen, 2009).

Findings were also unusual. Ms. P, who began her trial with little enthusiasm and distrust of a new method, ended the year with accolades from fellow teachers, happy parents, and very successful students. All fifteen children improved significantly. With no need for rewards or punishments she saw how children engaged easily when choice was co-created, solved difficult problems when mastery was co-created, connected effort to mastery and mastery to purpose. Beyond progress in literacy, she was very pleased to understand that in achieving these skills, she was merely connecting her students' innate capacity for syntax, grammar, and vocalization with white matter structures that also facilitated regional languages (Kannada, Hindi, and Sanskrit), and transferred easily to other academic subjects including Mathematics, Computer skills, and Environmental Science.

Tantalizing questions about this emerging field of brain-based teaching and learning remain for future research. In my laboratory in Seattle, we have already begun to look at two questions in detail. The understanding that 'structure' underpins 'function' is well established in neuroscience; what would happen if educators focused on neural structures rather than on memorizing content. Could teachers have meaningful success through growing white matter connections in areas of the cortical tissue associated with critical thinking by adjusting the learning environment so that children were invited to make mistakes in reading, writing, or mathematics. Educators are also interested in further explorations into understanding the impact of intentionality about intrinsic motivation over traditional extrinsic models.

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