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Reducing Math Anxiety and Strengthening STEM Pathways: A Conceptual-Pedagogical Approach

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Abstract

The development of skills among students in STEM fields is not only a pressing concern in countries like India and South Africa — it is a universal need. In an increasingly technology-driven world, building cognitive strength, attention capacity, and analytical reasoning from an early age has become a foundational requirement in education. While both India and South Africa have made progress in schooling, significant challenges remain, particularly in nurturing the critical thinking disposition among learners. This paper compares the two systems to observe visible gaps, especially in high school education, and examines how these gaps begin forming as early as childhood. The idea of learning through the body, particularly through the use of fingers, is explored with the support of Vedic mathematical techniques. A three-stage pedagogical approach is proposed, which not only introduces number concepts at an early age but also builds a bridge between the concrete and the abstract. This organic and tactile method reduces mathematics anxiety and fosters resilience. The Indian school system's restriction on calculator use until Grade 12 is noted to preserve cognitive engagement, whereas early reliance on calculators in South Africa may unintentionally hinder analytical development. This paper ultimately suggests that using one's own body as a natural learning tool not only improves numerical fluency but also cultivates a stronger critical thinking disposition, which is essential for solving the larger issue of STEM skill shortages in the future.

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1. Introduction

What is the purpose and method of education? It depends on who and where the education is provided. Is the scope of the issue local or global? In the current context, every nation has their own issues to address, and they mostly aim at developing required skills among the learners for the society locally or globally. The skills include, but are not limited to, dealing with problems and challenges with mental and physical development, being able to come up with new ideas, working by agreement with others, and being responsible. These are also called the 21st-century skills for students (Kartal, 2020; Senemoğlu, 2018; P21, 2016; Trilling & Fadel, 2010; Thomas, 2004). Education has its two vital components. They are the students and the teachers. Therefore, there exists the need for 21st-century skills for teachers. The 21st-century skills as identified for teachers are those that guide and help to provide effective classroom management, an approach that confirms the right behaviours, the use of technology and pedagogy skills together, the production of materials, and the assurance of teaching regardless of the classroom environment (Orhan-Göksün, 2016).

There is no question that the goal of education should be to improve integral training of individuals and promote quality of life in society (González-Pérez & Ramírez-Montoya, 2022). A sustainable development is only possible when, along with proper training, merit is encouraged. Education should be able to train every individual to compete and adapt. No individual students are the same and should never expect to have

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the same result or gain in real-life conditions. They must know the value of merit over all aspects of social conditions. Instead of talking about inclusivity or equity, the focus of education should be on meritocracy. We should make every effort to assist students in enhancing their skills, regardless of their social backgrounds. It is beyond doubt that learning is a lifelong factor (UN, n.d.). Also, we need to understand that necessity makes us learn. Our education must focus on teaching skills along with contextualising the skills with a daily life situation of students. Learning and skill development mostly depend on the attitude of individual students and have been demonstrated elsewhere (Chowdhury et al., 2020). Today's education has to focus on three important components. They are learning, literacy, and life skills (P21, 2016).

One important point to be noted here is that 21st-century learner skills and 21st-century teacher skills are developed in interactions, not in isolation (Dağhan, Nuhoğlu-Kibar, Menzi-Çetin, Telli & Akkoyunlu, 2017; Orhan-Göksün & Kurt, 2017; Kıyasoğlu & Çeviker-Ay, 2020). The author suggests that today's educational models incorporate modules that help students develop complex reasoning competencies and auto-systemic thinking to support problem solving and critical thinking and finally address social needs.

1.1. Skills and learning

Before we proceed, let us understand our capacity. Be it physical or mental capacity (ability). Everything we do depends on our capacity. That could be cognitive abilities or physical abilities of individuals, but all our activities are controlled by and depend on our brain, the way it works. While considering the brain, we have different sections in our brain, and they are assigned to perform different kinds of tasks (Chowdhury & Sepeng, 2023). We improve our capacity through our experiences. That is why it becomes very important for an individual to train their brain compartments, working in collaboration with each section. A simple analogy might help the concept of training the brain in a better way. There are individuals attending the gym to improve their physical structure and functionality. They engage their muscles, or body cells, in specific tasks to enhance their physical abilities. The same way an individual has to work out brain cells so that the functional capacity of brain cells gets improved. We must realise that we are born with over a trillion of synapses (connections) in our brains. Also, they are compartmentalised at different portions of our brain. What becomes more important for us to understand is that the brain structure is not static like our body muscles. Rather, it is dynamic in nature. Our brain produces new neurons, loses old neurons, makes new connections, or loses old connections based on their interactions with the environment. There exists a paradigm that aligns with the brain's natural way of learning and suggests that the changes within our brain structure depend on either positive and sustained or negative and intense interactions (Jensen, 2008). We could find a person who is excellent in literary activities or in artistic traits but poor in mathematical skills or reasoning activities. It is now understood that this only happens due to the uses and non-uses of certain portions of the brain cells. Our education system, including the teaching-learning process, should focus on increasing positive and sustained interactions between a learner and the environment. The author suggests that the whole school, including the classroom activities, comes under the ambit of a learner's environment. Keeping all complexity aside, we can safely oversimplify the brain functions to say that a more active right hemisphere of the brain improves the literary skills of a person. On the other hand, the brain has a nominal capacity to master both the numerical and artistic traits.

The idea of education should be the manifestation of the capacity of our brain to its highest potential. As a parent, politician, and community member, it is important for us to realise that education is not a rat race for getting a university degree or a key for getting a job. Education is a means of learning something that enhances one's existing ability to do a job in such a way that the person is hired to achieve the employer's need. The function of a schooling system is to identify the capability of every individual, assist in improving their skills in the required fields while keeping a balance between the interests and abilities of individual students, and prepare them to join the future workforce of the social system. While preparing children for the needs of our society, individual capacity or their abilities play an important role. A skill is the talent of an individual. Going back to our gym analogy, if 100 people are attending the gym in a day, none of the 100 show the same physical strength or abilities. This is what diversity is. No two individuals are the same and are expected to show the same abilities, be it physical or mental. Talent depends on the external and internal construct of an individual. Talent helps an individual to become an expert in a specific field. An individual's brain and genes work harmoniously to monitor and develop talent. We have around 25,000 genes. Every cell in our body carries all of the genes, but only a few are dominant within a cell, while others remain non-functional. Every practicing teacher needs to note that, as in the case of brain structure, genes that are present in our body cells (including our brain cells) also change their structure and activities depending on the uses of our body cells. Probably that is why Flavell (1985) suggested the possibility of teaching any topic at any level using appropriate pedagogy. How is it known that someone carries a certain ability hidden within? This comes out as an interest shown by the individual concerned when exposed to a multifunctional environment. Modern schooling systems have to maintain a balance between traits existing within a person, the interest of the person, and the necessity of the society for maintaining its progress. Whether able to maintain this balance or not, our schools have been successfully supplying a workforce to society through the formal schooling systems. These includes primary schools, middle schools, high schools, and higher education institutes. Before allowing entry of any individual to the higher education system for getting professional or semi-professional training, each individual is made to cross certain barriers, what we call as school education system (spanning from primary to secondary schools).

Several researchers have observed that early exposure to symbolic mathematics without sufficient grounding in concrete experience leads to cognitive overload and anxiety. Ashcraft and Krause (2007) showed that working memory gets quickly exhausted in young learners when abstract operations are introduced too early. When children are encouraged to use their fingers to count or relate numbers to objects, the cognitive burden is reduced, and learning becomes more intuitive (Ramirez et al., 2013). This paper aligns with those findings but adds a culturally rooted dimension — the Indian method of embodied mathematics, especially through finger lines and Vedic techniques — which further stabilizes the child's mental map of numbers and operations.

1.2. An overview

Prior to joining the academic community of South Africa, this author taught in Indian schools for almost two decades, holding different responsibilities covering different curricula. This article is prepared to understand the problem of the school education system after comparing both the Indian high school system and the South African high school system.

It is understood that whenever any information is cited in an academic paper without its' reference source, it becomes an anecdote and hence loses its credibility. The author completed his high school in India (1975) and worked as a high school teacher in India for over two decades (1980-2005). He continued to work as a high school teacher in South Africa for approximately another two decades, from 2006 to 2022. The presentations made in the next paragraphs are based on the author's firsthand experiences gathered during his tenure in the system.

India is a land of around one and a half billion people with 36 provincial structures and the world's most complex high school education system. India has at least 22 different state-recognized languages other than English. The country has at least three different established high school education systems. There exist state education boards controlled and maintained by each individual state government (22 of them, as of now), the Central Board of Secondary Education (CBSE), and the Indian Council of Secondary Education (ICSE). Prior to 1975, there existed two different high school exit points for Indian high schools. After 10 years of schooling, writing a board-controlled test known to be a school final examination. After 11 years of schooling, writing a board-controlled test is known to be a higher secondary examination. In both cases, students were allowed to join the tertiary courses after successfully completing their school board examination. After long years of tug of war, all boards in India at present adopted a uniform two-stage school exit point. The first exit point is at grade ten with a general education where learners are taught languages, simple mathematics, general sciences, and social sciences. The second exit point of the high school system is two years of schooling at post-grade ten. This is known as the higher secondary examination. Learners are prepared for specialised university courses at this level. This level is the gateway for higher education in India. There are a few institutes that cover the international curricula at school levels. They are International Baccalaureate (IB), Cambridge International Examinations (CIE), Edexcel, etc.

On the other hand, South Africa boasts a population of approximately 63 million, spread across nine states and is home to at least 10 distinct spoken languages, including English. The school education system of South Africa underwent several changes in years. South Africa divided its education system into eighteen severely segregated divisions prior to 1994. The period 1994-1999 saw the consolidation of these divisions into a single national department and nine provincial departments (Chisholm, 2012). It is clear from the way the South African Department of Education, dubbed the Department of Basic Education, operates that it is the central authority for all policy formulation, monitoring, and evaluation. To address the curricular distinctions of the past, the first post-apartheid curriculum overhaul occurred in 1997 (Motshekga, 2011). In its present form, South African schools offer a three-year compulsory course for becoming a high school graduate. A student has to study from grade 10 to 12 before being eligible to write a school exit program (test). This examination is called the National School Certificate Examination (NSCE). The contrast between South African school systems and their Indian counterparts is that in South Africa, there exists no school exit point prior to grade 12. Other than the CAPS curriculum, some other curricula, such as the Independent Examination Board (IEB), Cambridge International Examinations (CIE), etc., are also offered in South African schools. Both the Indian and South African education systems cater to a highly diverse community towards serving a united society. Both countries are culturally and linguistically diverse in nature. There are places in both countries where one can find that within a distance of a few kilometres, people are speaking a completely different language. We are here to ponder if the changes brought in our education system are able to make a positive impact on individual and social growth.

When a country faces both high youth unemployment and a shortage of STEM professionals, the gap is not just in infrastructure — it is pedagogical. South Africa's schooling system, despite its rising National Senior Certificate pass rates, has seen declining interest in STEM subjects (Spaull, 2013). Allowing calculators at a very young age, though practical, might come at the cost of diminishing mental calculation skills. In contrast, the Indian system delays technological aid until higher grades, thereby strengthening core mathematical thinking. The solution, however, is not to copy one system over the other but to adopt early, body-based, low-cost methods that help all children develop numerical fluency naturally.

1.3. What are we missing

The goal of high school systems in any country is to prepare children to successfully participate in the higher education system to prepare themselves to be an expert in a specific field of their choice and contribute towards the economic development of themselves and the nation. How far has South Africa achieved this goal of education? An AI overview (conducted on 28th March 2025) showed that South Africa has the highest unemployment rate (UR) (33.9%) among the G-20 countries in 2024. According to a report of the Ministry of Labour and Employment, Government of India (31-January-2025, PIB, Delhi), India’s UR stands at 3.2%. What looks more disturbing to the author is that almost half of the youth population of South Africa is unemployed. To be more precise, approximately 33% of the population of South Africa is youth and almost 46% of them are unemployed (25 February-2025, Statistics South Africa report). On the other hand, when we look at the job market of South Africa, we observe a shortage of skilled workforce. Most of these skills, where the country is facing a shortage, relate to mathematics and science (STEM fields). This shortage spans from IT professionals to high school teachers who are capable of teaching pure mathematics and physical sciences. Indicates the presence of certain gaps in the South African schooling system that is failing to prepare high school goers to take up STEM related courses at their tertiary levels.

2. Methods

The development of a country is determined based on its industrial growth. Industrial growth improves the economic conditions of its citizens by allowing them to participate in different industrial activities. This could range from a technician to a typical designer or industrial manager position. All this workforce is needed for industries that come out of higher education institutes, which get their input from the existing high school systems of a country. They typically receive instruction and training in various STEM related subjects from their high schools. How do South African schools contribute towards the growth of STEM education? In the next paragraphs of this paper, we focus on South African schools’ contribution towards STEM learning at higher education contexts.

This study employed a comparative, document-based approach supported by descriptive statistics. National-level data from South Africa’s Department of Basic Education (DBE) is used to analyse participation trends in STEM subjects across the years 2022 to 2024. Statistical information such as pass rates and subject enrolment percentages are presented in tabular form to support trend interpretation. These quantitative observations of secondary data are then interpreted alongside qualitative classroom observations and cross-national comparisons with Indian education policies. Though the study does not apply advanced inferential techniques, it draws meaningful insights from descriptive statistics and observable trends.

3. Results & Discussions

The National Senior Certificate-2024 (NSC-2024), South Africa achieved the highest pass rate of 87.3% but with a decreased participation in the STEM-related subjects. A comparative record is presented, in Table 1 for the years 2022, 2023, and 2024 (DBE, 2024).

Table 1. Number of students who wrote the subject

Subject	2022	2023	2024
Mathematics	269734	262016	251488
Physical Sciences	209004	206399	200715
Accounting	104798	100974	97636
Life Sciences	399007	379024	374722
Agricultural Sciences	125353	115894	114261

While observing the data in Table 1, we observe a fall in participation in all the STEM-related subjects taught in the majority of the South African schools. Table 2 (DBE, 2024) presents the drop in percentage for 2022 and 2024.

Table 2. Drop in student participation for 2022-2024

Subject	% Drop between 2022 and 2024
Mathematics	6.764
Physical Sciences	3.966
Accounting	6.834
Life Sciences	6.086
Agricultural Sciences	8.848

All is not bad in South African schools. 101 schools out of 6925 have been able to produce 100% results continuously from 2020 to 2024, and only one school performed below 40% continuously over a period of five years (DBE, 2024). There could be a good case study on these schools to promote and encourage better practices in improving students' achievement at the NSC level. Another good piece of news for South African schools is that they are performing better than in previous years. It means efforts taken in improving students' achievement are bringing in the desired result. An analysis for 2022 to 2024 STEM-related subjects is presented in Table 3. Except for Physical Sciences and Accounting, the pass rate has shown a two-digit growth for all other subjects considered in this study (DBE, 2024). What is more encouraging here is the growth in mathematics performance. Pass percentage has increased by 20.4% from 2022 to 2024 (DBE, 2024).

Table 3. % Pass in years

Subject	2022	2023	2024	% Gain from 2022-2024
Physical Sciences	74.6	76.2	75.6	1.323
Accounting	75.4	76.8	81.2	7.143
Life Sciences	71.5	75.6	80.8	11.501
Agricultural Sciences	75.8	80.5	86.9	12.773
Mathematics	55.0	63.5	69.1	20.405

It becomes important to understand the impact of both the under-participation and better performance on the STEM participation. Considering mathematics as a sample subject, we observe a total pass in mathematics of 148353 for 2022, which is 55% of 269734. Similarly, we observe that 173778 passed in 2024. There is an increase of 25425 students who are joining the STEM forces post-2024 NCS examination result. Now, Physical Science in the list showing the least growth in terms of pass percentage needs to be examined for its impact on STEM education. In 2022, the total pass-outs in physical sciences were 155917, and in 2024 they were 151740. The number of students in the STEM field decreased by 4177.

This suggests higher contributions by schools towards STEM related subjects are possible by increasing the achievement with limited or restricted entry at the school level. Every individual has a hidden ability and interest in doing every work. Some of these traits are more prominent than the others. Individuals are nurtured and provide the opportunity to work on these skills at the formative stages of their growth using a school system called primary and high schools.

Now the question comes: how to help students at their formative stages? Analytical thinking skills are an important 21st-century skill that helps improve achievement in STEM subjects. These subjects include as chemistry (Yulina et al., 2019), physics (Zakyratka Putri, Cari & Sunarno, 2019), and mathematics (Whitney-Smith, Hurrel, & Day, 2022). Analytical thinking skill is an essential 21st-century survival skill (Zakyratka Putri, Cari & Sunarno, 2019). It is observed that knowing mathematics is an essential precondition for learning chemistry (a major content of physical sciences taught in South African schools) and achieving future success in this field (Ralph & Lewis, 2018; Rodriguez et al., 2018; Bain & Towns, 2016). Our observation on the 2024 NSC (Table 3) result contradicts these studies. The gap in improvement in performance between mathematics and physical science (which contains both chemistry and physics) is a staggering 19.1% (Table 3). This disparity reminds us of the drawbacks of teaching using a problem-solving method. In problem-solving, stress is given more on analytics than on conceptual development (Sanger et al., 2013). There exist suggestions on blending mathematical and reasoning skills while teaching subjects like chemistry (Rodriguez et al., 2019; Bain, Rodriguez & Towns, 2018).

In the process of learning sciences, students' also need to learn requisite survival skills for 21st-century because skills required in 21st-century are different than that were required in the 20th-century. The 20th century observed an escalation of industrial activities, and 21st century is experiencing an information explosion (Bawden & Robinson, 2020). Synchronising the learning of science with the learning of 21st-century skills should be the call of the day. While recommending 21st-century skills it is important to note that there exist two sets of 21st-century skills. One set is for teachers (Kıyasoğlu & Çeviker-Ay, 2020; Orhan-Göksün & Kurt, 2017) and the other set is for students (Senemoğlu, 2018; Trilling & Fadel, 2009). Implications are, firstly, teachers will need specific skills to prepare students for 21st-century survival, and secondly, students need to master certain skills in order to survive in the 21st century. A set of six skills is considered an essential part of cognitive skills for survival in the 21st century (Chowdhury, 2022). They are attention, memorisation, perception, mobility, processing, and logic and argumentation skills (Chowdhury, 2022). Three of these viz., attention, memorisation, and processing skills, are fundamental in developing better analytical thinking skills. Visual–spatial memory shows a comparable association with mathematical ability (Xie et al., 2020). The association of spatial memory and mathematical ability was found to be similar for both the children and the adolescents (Xie et al., 2020); hence, it is argued, every science student must be encouraged to improve their memorisation skills in a mathematical context. As an example, remembering multiplication tables can help students process small mathematical problems in science content faster with accuracy. Now, the question comes: how to develop spatial memorisation skills? They can neither be improved by using a book or classroom instructions nor is there any curricula or methods to assist in developing spatial memory (Lin, Chen & Lou, 2014). The same is true for critical thinking. Unless this mindset is nurtured from the early stages of education, critical thinking remains a mechanical exercise rather than an authentic engagement with ideas. It is observed that instead of calling it critical thinking skills, pedagogy experts prefer to call it critical thinking disposition (Demir, 2022). Critical thinking disposition stands out as something deeper than just knowing how to think logically. It is not about solving textbook problems alone. It is about developing a natural tendency to question, to reflect, and to look beyond what is obvious. Critical thinking disposition involves an internal motivation — a habit of mind — that encourages learners to be curious, open to reason, and willing to persist even when answers are not easy (Facione, 1990).

Disposition in the true sense explains more about the critical thinking ability of an individual. It covers habits, behavioural trends, and the inclination of an individual, though influenced by experience but much finer in nature. It covers traits like curiosity, empathy, resilience, persistence, open-mindedness, and growth mindset. What is more interesting to observe is that there exists a positive correlation between analytical skills and critical thinking disposition (skills). Which helps us to conclude that for developing 21st-century critical thinking skills (disposition) we must concentrate on developing analytical skills among South

African school students. It is understood from a study that training in Vedic mathematics (VM) can help improving cognitive skills as well remove mathematics anxiety from students' mind (Shastri et al., 2016). Use of games like treasure hunts has also been suggested for improving spatial memory (Lin, Chen & Lou, 2014).

3.1. A suggestion

In India, a chemistry postgraduate is not allowed to teach physics or mathematics at grades 11 and 12. In order to teach in grades 11 and 12, one must have a postgraduate degree in that subject. If not, an honors degree in the subject area is wanted. One cannot study an honors degree in more than one subject in one study period. In South Africa, a teacher can teach any subject in grades 11 and 12 without any postgraduate degree in the subject. Another interesting observation made by this author is that students are using calculators from their primary schools, reducing their analytical skills. On the other hand, in India, students are not allowed to touch a calculator till the completion of their grade 12. This clearly enhances the analytical skills of students studying STEM subjects at this level. This author completed his BSc degree without any calculator, that too in physics, chemistry, and mathematics.

It is observed that a typical Indian way of mathematical calculation can help children develop robust analytical skills faster and independently of any external gadget. We refer to this method as Vedic Mathematics (Sharma, Khubnani & Subramanyam, 2022). Use of Vedic mathematical techniques can help improve spatial memory, increase the level of attention, and increase the level of mobility (mental) of a child.

There exists another seemingly simple but powerful technique—counting on fingers—which has been recognised by both ancient Indian civilisation (Burnell, 1880; Namboothiri.com, n.d.) and modern scholars (Butterworth, 1999; Ifrah, 2000). Example of a structured finger-based counting is found in the ancient *Hastāṅgulījapa* method, where a particular joint on the middle finger is taken as a starting point and methodically moved through finger joints in cycles of nine, completing twelve cycles to achieve a full count of 108 mantras (Ahimsa Bharti, n.d.)

The act of recognizing one's own fingers and using them deliberately is not as simple as it appears. In fact, neuroscience gives a name to this subtle awareness — it is called finger gnosia. This is the ability to identify, differentiate, and mentally picture one's own fingers. Children with better finger gnosia have shown stronger early number sense and higher arithmetic fluency. When a child aligns their thumb with a specific finger line while trying to count or locate a number, it is not just a physical action — it is a cognitive event. This process connects spatial memory with numerical reasoning. Research has found a strong correlation between finger gnosia and mathematical ability in young learners (Penner-Wilger & Anderson, 2008). From this angle, the pedagogy proposed in this paper — using finger lines and bodily interaction with numbers — does more than teach counting. It quietly builds a deeper connection between body awareness and number processing, laying the foundation for stronger analytical skills in the future.

Upcoming sections suggest a three-stage method for improving mathematical skills, analytical skills, and critical thinking dispositions at the very formative years of school children, both toddlers and infants. This approach, while grounded in classroom observation and tradition, also finds support in contemporary cognitive science. The idea of using finger lines is not merely cultural — it has a neurological basis. Studies in embodied cognition (Fischer, 2008) have shown that finger counting habits influence spatial-numerical associations, helping children build strong internal number lines. Penner-Wilger and Anderson (2008) further emphasised that finger awareness (gnosia) correlates with early math performance. In the Indian context, this is further supported by Vedic mathematical practices which emphasize pattern recognition, mental mobility, and rapid recall — all built on a structured yet playful system of operations. This combination of body, mind, and tradition offers a holistic approach to mathematics that goes beyond rote memorization (Mishra et al., 2025; Mahajan, 2023).

3.2. Stage One

We are playing a game of 'count the numbers' using the right palm. Little finger is counted from 1 to 4. The ring finger also counts to four, but this time it starts from 5 and goes up to 8. Finally, the middle finger is counting 9 and 10 from its bottom. A child has to count using the thumb by putting the thumb on specific points from the little finger to the middle finger and learn counting from 1 to 10 over the right-hand palm (Figure 1).

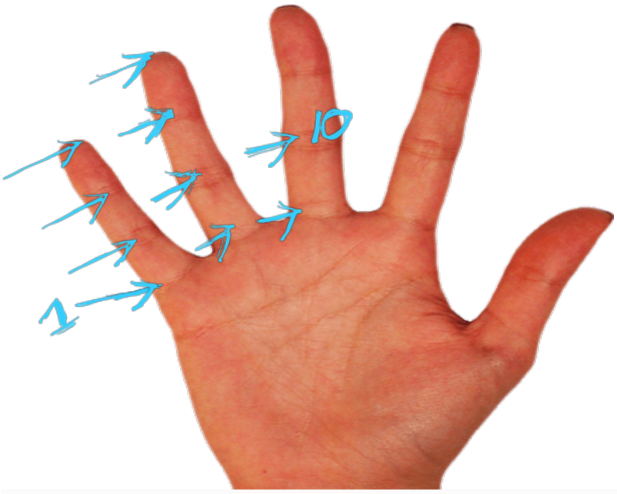

Figure 1. Places on fingers corresponding a specific number

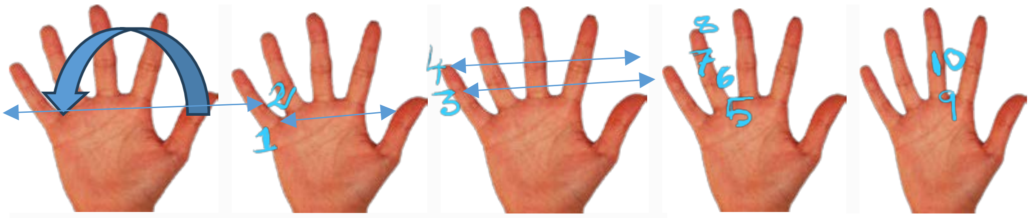

Figure 2. Motion of thumb for identifying a number (1 to 10)

As we look at our fingers, we find three distinct lines and the top of the figure (Figure 1). Figure 2 assigns a fixed number to each point of the respective position, ranging from 1 to 10. A child learns to count the respective number by associating each finger position with a specific number. Just like a game of finding a number on the finger lines, almost like a treasure hunt (Lin, Chen & Lou, 2014). Topic-specific pedagogic content knowledge (TSPCK) of the teacher will make the lesson more or less interesting to the children. Below, we present further benefits of counting on fingers.

1. *Developing the psychomotor skill of controlling a part of the body. Developing a habit of practicing a difficult task to its perfection from the beginning of their learning career.*
2. *Gaining the ability to pay attention to the instructions given by the teacher while performing a significant psychomotor action.*
3. *Co-ordinating the motion of the thumb while using spatial memory to remember exact points corresponding to a given number (at the initial stage). Helps improve spatial memory.*
4. *Be able to handle complex arithmetical calculations mentally at a later stage.*
5. *Developing perceptions of numbers. The process involves coordinating the concept of actual quantity with the position of the palms on the right and left hands.*
6. *At a later stage, develop the skill of counting and adding numbers till 20 on palm fingers or mentally.*
7. *The whole process helps develop processing skills.*
8. *Induce skills of application of logic while learning to count or add.*
9. *Bring in improvement in the thought process and mental mobility.*
10. *Finally improves the critical thinking disposition of a child.*

A child also develops muscle memory to identify the position with a specific value from 1 to 10. Learn the logic of adding two digits up to 10. Become an expert at adding up to 10 or subtracting from 10 downwards without even writing the numbers on a paper. Finally, develop critical thinking in dealing with numbers. For example, 2 plus (added to) 3 has to be 5. Or, 7 plus 3 to 10. 3 subtracted from 5. Otherwise, we say 5 minus 3; they find the logic of getting 2. This process can continue till perfection.

3.3. Stage Two

After a child is competent enough in handling the digits (numbers) up to ten using their right-hand palm, they are then introduced to using their left-hand palm. The counting now starts with 11 (Figure 3). The left hand's little finger's first line is 11, and the second line of the middle finger is 20. They can now get fluency in adding any two digits using both of their palms. Such as, 9 + 3 = 12 or 5 + 8 = 13. The maximum number they will get is 9 + 9 = 18. They learn the concept of carryover. What is more intriguing for them to understand is that the carryover is always 1.

Figure 3. Counting on left palm

3.4. Stage Three

At this stage of learning the numbers, introduce writing the numbers to add them in a single row. Children will simultaneously write the numbers, count on the finger lines, and write the result.

2	7	5 6	or	4 5 6 7 8
8	2	9 8		6 5 7 3 4

Introduce the game of adding numbers as shown in the table (Table 4).

Table 4. Developing an addition table

A	B	C	D
1	2	3	4
2	4	6	8
3	6	9	12
4	8	12	16
5	10	15	20
6	12	18	24
7	14	21	28
8	16	24	32
9	18	27	36

Look at column one and row one of the tables (Table 4). A child has to add 1 to get the next number. The length of both the column and row can very well be extended depending on the skill improvement of children. Children can learn the concept of multiplication using the same table. Such as, 9 x 1 = 9 or 9 x 3 = 27 etc. As they grow, introduce different aspects of Vedic mathematics (Chowdhury & Sepeng) to them.

4. Conclusion

The concept of a number is abstract, but for a child, abstraction is born from repeated interactions with concrete experiences. Whether it's a banana, a car, or a coin the number "one" is universally applicable. However, when that number detaches from a unit, it creates confusion. This confusion, if left unresolved, can slowly turn into mathematics anxiety. The act of asking questions—"What is this?" "What happens when...?"—begins the journey of critical thinking. Finger lines provide a real, natural way for infants to develop a bond with numbers, while thumb movements train the mind in resilience and sequencing. Children, through this, begin moving from concrete to abstract, gradually and joyfully. Linking this early training with Vedic mathematics can significantly enhance attention, mental mobility, and spatial memory. While India restricts calculator use in school years and maintains subject-wise teaching qualifications, South Africa permits calculator use from early years and allows subject-fluid teaching in higher grades. This paper emphasises that early intervention, using our own body as a pedagogical tool, is key to building a generation of analytical and independent learners. The method suggested here is simple, natural, and deeply rooted in the human experience. Policymakers are invited to consider this low-cost, body-based pedagogy and explore its impact through pilot projects—not just to build skills but to shape confident, curious minds.

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