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# Azim Premji University Learning Curve

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# Teaching Learning Materials and Aids

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*"Learning Curve is a publication on education from Azim Premji University. It aims to reach out to teachers, teacher educators, school heads, education functionaries, parents and NGOs, on contextual and thematic issues that have an enduring relevance and value to help practitioners. It provides a platform for the expression of varied opinions, perspectives, encourages new and informed positions, thought-provoking points of view and stories of innovation. The approach is a balance between being an 'academic' and 'practitioner' oriented magazine."*

# FROM THE EDITOR

Teaching Learning Materials (TLMs) and Aids, which form the focus of this issue of Learning Curve, an indispensable part of a teacher's bag of tricks, is a generic term that describes any material that supports and buttresses teachers' efforts in getting a class of diverse capabilities to understand the basics of any learning. They have to fulfil some basic requirements: simplify concepts, provide the chance of practice, increase interest and motivation, help to explain complexities, concretise abstractions, enrich the course - though, of course, a single TLM may not meet all the above criteria.

Thus, they are various kinds of TLMs, starting with the humble, but ever-present, blackboard (which has come in for much adverse criticism) and going all the way up to 'smart classrooms', with all the advanced technology they entail.

TLMs differ from 'resources' in that they are much more practical, involving both the teacher and student, inviting active participation from both in the process of gaining skills, information and, finally, knowledge. The differences are only a matter of degree - a worksheet, for example, is a very basic TLM. It can help an individual child to estimate exactly how much she has learnt and what gaps there are in her understanding. At the other end of the scale is the collaborative learning that comes from using TLMs such as models and charts which have been created by the students themselves with just the support of and suggestions from the teacher. We all know how rewarding such an experience can be. In the process of creating a chart or model for a concept in geography, for instance, many other learnings take place, including the discovery of talents that the student did not her/himself know s/he possessed. To instantiate - a student who discovered her talent for drawing and creative picturisation in the eighth class is today a well-known children's book illustrator!

TLMs have the added value of aiding the memory - when children see how a concept/rule of language/ experiment works, it is more likely to stay in the active memory than just learning the same thing by heart. This is particularly true when children have actively participated in the creation of the TLM, which is so much more effective than buying the same TLM from the market.

In this, the digital age audio-visual aids and smart classrooms are considered to be much more effective and therefore much more sought-after than more traditional TLMs, which however have the advantage of being able to be created and used without complicated requirements such as uninterrupted power or projector and screen and so on. Audio-visual aids can of course be vivid and therefore memorable, but they can also make learners a passive audience.

This issue presents a wide variety of opinions and experiences with TLMs and Aids. The role of TLMs as a generic tool has been examined - are we just going to tick off the ones used or are they going to make the vital difference between confusion and clarity? Other articles have dealt with individual experiences across the board. In one article, the writer refers to a colleague who made the life-changing discovery that the simplest articles of daily usage can be TLMs. Another examines a magazine as a TLM and the multiple uses it has been put to, with the most rewarding results.

In such a scenario, we can expect some very interesting reading - and valuable reflections - on what, as teachers, we can do to make the process of learning the exciting journey it is. We look forward to feedback which can be addressed to the email id given below.

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# Evolving Perception of Materials

**Hridaykant Dewan**

Materials can be important for helping children learn. The very young child learns in interaction with and acting on the objects around her. In the beginning, the senses, motor abilities and subsequent causal analysis develops through their observations of the things around and their behaviour in different circumstances. This interaction with materials is spontaneous and directed by the child. The manner of interaction is decided by her and often their explorations do not meet with the approval of the adults. There is a certain obstinacy in their toying around and extending boundaries of the pre-decided purposes, expected behaviour patterns and other such constraints. We have, as adults, played with children in the games they create in their effort to explore materials. Even when we bring in objects for specific purposes and specific motives they find their own purposes and manner of interaction.

This interaction, in a sense, play with materials, is essential for learning. This sense of materials is different in two important ways from the way Teaching Learning Materials (TLMs) are conceptualised. One, these materials are not specific to one area of learning and not certainly limited to a few concepts and, second, they are not specifically associated with the idea of teaching and learning. These points are important, as are some others, for us to understand the possibilities, risks and advantages of talking about TLMs for the classroom, where materials and situations need to allow and create opportunities for children to tinker and do what may be called brief studies for themselves. It is therefore important to keep in mind the principles that govern this usage and the concerns and the questions that we must be aware of as teachers and as curriculum or material developers.

The other point is about the nature of learning and concepts. Human concepts and the conceptual structures built on them are retained in the absence of materials and indeed the entire here and now of the situation. We have by now developed the ability to talk about and visualise objects and events in their absence. The purpose of learning is also to move away from concreteness and engage with ideas and constructs and even build combinations that have not been seen or are never seen and maybe do not exist yet. These imaginations are built in the mind and we want to sharpen this ability too, the implication being the need to consider materials as props and temporary aids and use them as means to develop the ability for abstractions. This is apart from their being an essential part of our lives and experiences where we work with and upon them. The point is that we have to learn to go beyond them in our imaginations and even our conversations as we name something and associate with it properties and behaviour that keeps getting modified and built upon.The question is thus not about the need or otherwise of materials but is about the purpose, context and manner of use.

It is often argued that most learning theories and researchers in that field have suggested use of materials. The Montessori programme talks of going from the concrete to the abstract. Also, Piaget and Vygotsky among others talk about going from concrete ideas to abstractions. It is however, important that the suggested use and importance of materials for learning be nuanced. They do not all imply that concrete materials are the most crucial and critical factors for learning, nor are they suggested as essential for learning everything. They recommend situations that allow children opportunities of tinkering, exploring, playing around, doing small experiments and studies. Vygotsky, in his formulations, underlines the role of the adult as a more knowledgeable peer and suggests situated human interaction and dialogue as essential for learning.

Thus, the principles behind the theories do not necessarily recommend physical materials but what they imply is that ideas and concepts must be embedded in contexts that are concrete for the learners. These may include experiences that they have had before, with the learning being the organising of these experiences under a new conceptual framework. It also does not mean that physical materials and objects define learning possibilities. The essence of the message whether we look at Piaget, Vygotsky or Bruner is that the child must be active in the process of learning, but simultaneously the learner is expected to apply her mind to organise the materials, her experiences with them and her observations on her own terms based on her previous knowledge system. For Vygotsky this occurs along with social interaction.

These points are critical when thinking of creating, or choosing materials and constructing ways of using them in the classrooms. The emphasis has to be on guiding the learning process such that children can have opportunities to exercise all aspects of their ability and use the language available to them to reconstruct or modify the way they have organised their knowledge of the world. Almost all the serious educators who have emphasised concreteness of the learning experiences in their work, have simultaneously emphasised cooperative and collaborative tasks with a lot of dialogue and discussion. The sense of materials and learning situations embedded in ideas of Dewey, also reflected in Nai Talim and many other educators recommend concreteness of engagements and purposes, rather than of physical materials. The learning tasks are required to be embedded in the experiences, language and environment of children and be useful for the community as well. The linkage of learning to work that is useful for the community is also considered important for facilitating interaction and sharing. We will now briefly examine the present focus in use of materials, the discourse around them and how the idea has grown in recent decades.

**Using Materials as Aids**

The use of materials started as an aid to the teaching process that emphasised giving information as the primary objective. Materials were used only to aid the memorisation of information considered important, repetition of tasks to acquire the ability to do the same and rote learning of available explanations, descriptions and even arguments. The expectations of the curriculum were limited to recapitulation and reproduction was the only mandate. No application of knowledge was asked for or expected.

However, in order to do this well, teachers were urged to go beyond chalk and talk. Information was to be presented such that it became more striking and hence retained. The initial use of materials was, therefore, a means to aid the transfer of information and make it more effective. Teaching aids like visuals made of charts, thermocol, slides, etc presented a model and showed the entire information content in chunks. It was meant to simplify and present information slowly and tangibly so that learners could grasp it bit by bit. It was thought that this would reduce the mental effort needed by children to acquire and reproduce desired information and add an element of novelty and excitement. Materials have been therefore seen as sugarcoats on, bitter pills to be swallowed.

The first set of TLMs, therefore, was teaching aids. The focus on these was to show children in attractive ways what they had to learn. The object was not to engage them mentally or excite their curiosity and enable them to focus on the presented objects or its experiences, but use it as aids for memorisation or merely as interesting distractions. The exercise of using teaching aids led to posters, slide shows, models made from different kind of materials, models bought or made by teachers. These were aligned with ideas prevalent at the time on what knowledge is to be acquired, how humans learn and what it means to know.

Today supposedly under a very different set of human learning concepts we can see ideas of teaching aids as morphed into demonstration experiments, videos explaining ideas routinely or giving information. They have the same purpose and follow the same pedagogical principles as materials followed seven decades ago.

**Active Materials**

Teaching aids were criticised as they failed to make the child active. It was argued that the purpose of classrooms is to have the child actively engaged in her own learning. This implies that materials must go into the hands of children. For this, flash cards, science kit materials, cut-outs, pocket boards, beads and strings, solid geometrical object and other similar things were emphasised. Due to the effort of institutions within and outside the government,the norm to be achieved became that experiments are important for science education. The purposes and pedagogical principles driving these materials were mixed: the same materials were presented but used very differently by different groups.

By 1986 even the National Education Policy (NEP 1986) emphasised the use of materials for primary classes and gave the indication of what these materials could be. A subsequent effort made in those years was to supply both science kits and materials to schools, but they mostly lay unused. The quality of the materials supplied, the nature of the write-off rules and the difficulties arising out of these are not sufficient to explain the absence of any significant use of these materials. Yet, the talk about materials got extended to upper primary and secondary classes as well; the presence of materials seemed a convenient way of showing yourself as different. They were also seen as distractions, breaks in the monotony for children. Activity rooms, language or maths labs, smart classrooms, interactive online learning, and such things became the norm. All this slowly led to a race for 'sophisticated materials' in private schools and a large market for materials of multiple kinds was created and is growing.

In recent times, the emphasis on ICT in learning has increased with a lot more investment. We have moved away from the use of physical objects, paper folding, flash cards, posters, charts etc. as a means to learn to visualise different shapes and objects or as means to depict parts of a whole. Based on experiences, beads and strings have been replaced by other forms of modelling of the natural number system and pictures and cards depicting fractional numbers by Dienes Blocks and other such specially constructed materials. There are kits for pre-designed experiments, working models and projects for students and teachers. These already constructed materials, tasks and structures of interaction, to be used with the children, have increasingly become prominent. 'Well formed' lesson plans with aids and materials, smart classrooms with installed packages available in the market have reduced the teacher's responsibilities to that of a materials store-keeper.

There is no doubt that there is now a lot of progress in thinking about materials and make them more 'efficient' and predictable and there is no doubt that materials can be useful and we must have them in classrooms. The point, however, is to ask whether the manner of use of materials leads to improvement in classroom transaction processes and if it does not, is there not something fundamentally wrong with our approach and understanding of materials and of concreteness of learning situations?

The conception of materials as aiding learning emerges from the need to develop engaging tasks for children, tasks that would help them engage with concepts and logical structures that can be created through using them in dialogue with peers and the teacher. This would require facilitating situations where they learn together and develop insights that, although not new knowledge, are new in the manner they have come about and are new for them. The novelty and the joy is not in the materials but in the engagement and the interaction surrounding the use of materials. The process of learning is not assumed to be linear and leading to a slow transfer of chunks of information, but a process of collective re-construction of concepts, imbibed in a specific manner by each child in the collective based on the structures she already has.

The purpose of materials is not activity but to make minds active and to make interaction between active minds possible. Materials are thus meant to extend the experience base and scope of learning and scaffold through various ways like temporary models, concrete illustrations, make possible engagement with concepts to elaborate them, the intent being to help the child exercise the ability to use the concepts and extend her abilities of building logical formulations cogently, observing and describing more sharply and so on. Its major purpose is not to simplify anything or to provide fun. To be relevant to the context, they have to be visualised based on the need by the teacher with collaborative inputs from the children so as to make both the purpose and the task accessible.

The basic set of materials that are available, including the concrete descriptions of experiences and observations of children, have to be moulded to suit the contextual requirements. And that can only happen if the materials and the learning tasks are controlled by the teacher (and to some extent aided by the children) and are not pre-decided impositions. Such impositions, even if well conceived, cannot be effectively used by the teacher or match the context. The possibility of these being well-conceived is therefore in itself impractical as we can not expect groups of children in the classrooms to be universal in the way they engage, interact and learn.

**The Current trend**

The current trend is a movement away from such use of creation that involves the whole class. Use of materials where teachers and children participate in, conceptualising, putting together and using materials. Use that leads to observations, experiences and then processes expecting children to make logical formulations to construct things and concepts. and in the process discovering insights that are new for them and are not from the textbook.

This understanding of materials emerged from the recognition of conceptual understanding as the goal. This goal demands that children formulate their own descriptions, their own logical constructs, their own articulations and expressions and therefore present their own answers. This is broadly aligned with some of the principles indicated by learning theorists as well as educators. The mistake, if we may call it that, was only to think that concrete operational stage means the same as work on concrete objects and that the use of materials helps to break up concepts into parts.

The points of view on the use of materials lie between materials being panacea for learning and their merely being supplementary to what the teacher can do. The journey from textbooks and library being materials and efforts to ensure their effective use to the subsequent use of pebbles, straw, things in nature, small kits and inexpensive things being considered TLMs has now rapidly moved to materials being specially curated products developed by 'experts'. The gap between what is stated as principles of learning and the beliefs that prevail aided by the push of the market leads to use of materials quite contrary to the principles and features of a good classroom embedded in the National Curriculum Framework. This is certainly a movement away from the understanding that it is the children and the materials that are important and the teacher is only a facilitator. The key, however, is that in reality, policies and programmes do not want to invest in teachers, with more and more investment on availability of materials and the over emphasis on materials without considering purposes and pedagogical principles has made active classrooms a fashionable word, with the idea that everything has to be activity based in the physical, novel and fun sense. The distinctions between play, game, engaged learning, experiment, and so on has been lost.

There are, of course, some educators who clearly state that the guidelines should be to produce foolproof materials as there cannot be sufficient resources for teachers and their preparations. Bureaucrats who double up as educators generally align themselves with this view and to add to the promotion, there are many for private companies working in education which are developing materials and manuals to aid/guide/direct the teacher. The emphasis is that the teacher has to just follow what is suggested and use the materials as directed. This perspective of materials and their use is certainly not the one suggested by advocates of concrete learning experiences as the foundations for learning.

The use of materials thus rests on the premise that good materials would help children learn irrespective of everything else, and well constructed thought through materials can make children learn on their own just as 'constructivism' would suggest. Children using prepared materials must be allowed to be free and not require much support. The emphasis on the use of materials comes from two opposite camps: one camp that says that materials would help the child repeat, practice and remember better and the other that suggests that they would help children learn automatically. Discussions hover between these two extreme views, but essentially they have the same roots as they posit the teaching learning process as individual and not social. The requirement that teachers engage children, help them structure their learning, continuously interact with them, assess them, encourage them, guide them, have a continuing dialogue with them and carry the responsibility of learning has been buried. The suggestion that materials must be special and require high effort and investment to conceptualise and design implies that they can not be developed at a small scale; not by the teacher in her school based on her needs and not even at the cluster and the block level. To make the best available to all and be able to make their production economically affordable the pressure is towards centralisation of their conceptualisation, development and production. They have thus to be universal and widely applicable. With no preparation of teachers to use them effectively and no discourse around multiple use of materials, there are no possibilities in the classrooms to use them for alternative purposes in alternative ways. The emphasis is on thinking of such TLMs as universal and developing them as such. Interactive systems are geared towards individuals and not groups and their responses aligned with the profiles entered.

**Conclusion**

TLMs are tools for the aid of teacher and children, unless there is clarity of purpose between these most critical players, materials can only be an obstruction to the exercise of the mind by the child. It may also be important to recognise that materials can retard the effort of visualisation and mental construction of ideas that are abstract even though they can be seen embedded in many live experiences and familiar objects. So unless the teacher is central to the project of thinking of, developing and deciding the use of materials our classrooms would continue to remain one-sided delivery. The only change being the retrograde one, that instead of the teacher it is now the materials that are the source of all knowledge and provide the learner with the purpose and content that is to be learnt. The conversation on teaching-learning materials thus needs to start from the purpose of using them and their material and conceptual accessibility to teachers and children. They should not be imposed learning trajectories and tasks to be followed mechanically.

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# Creative Use of Teaching-Learning Materials

**Kamala V Mukunda**

A few hundred thousand years ago, *Homo Sapiens* walked on African soil, searching for food, shelter, perhaps companionship. Externally, their lives were completely different from ours today—but inside our skulls, our brains are remarkably similar to those of our ancestors. Children on the African savannah did not go to school, but their young brains were perfectly adapted to learn from their environment over a period of several years. Since the time scale of evolutionary change is so slow, the structure and function of children's brains have not changed over the millennia. Learning from one's environment is an integral part of childhood, and those of us who teach or design learning environments should keep this in mind. In this essay, I hope to persuade readers that the creative use of teaching-learning materials is a powerful way to align schooling with the way children's brains are built to learn.

Childhood has evolved as a special stage of life, during which the individual has the time and opportunity to learn what it takes to survive in the particular situations into which he is born. For humans, this period of time can be as long as 18 years. Other animals either have shorter childhoods or need no parenting at all (for example, sea turtles are independent from their parents right from the moment they hatch). The disadvantage of shorter childhoods is a greater inflexibility in response to changes in the environment, because more has to be 'programmed' into the young, in the form of instincts. Instincts are responses to stimuli that have existed in the environment for millennia, so that if the environment changed abruptly, the same instinct could lead to death (for example newborn turtles move instinctively toward light, even if these are artificial lights strung along the beach). The value of our longer childhood is that we seem to have fewer programmed instincts, and therefore can learn to adapt to our environment over a period of time.

But to say that we have fewer instincts misses an important point; we are not born 'blank slates'. In fact, children have a lot of programmed instincts that make them *ready to learn*. This readiness to learn comes in the form of many strong tendencies and preferences that babies and children show, and if we want to teach them, we should work with these forces rather than ignoring or countering them.

One big mistake we have made is to forget that children are designed to learn from real-world environments. Decades of psychological research has documented how just in the first few years of life, children spontaneously develop an impressive and complex understanding in several domains of knowledge. They seem particularly tuned to the domains of language, of number and space, the properties and types of living things, the behaviour and thinking of other human beings and the properties and mechanics of physical objects. Through interaction, feedback, repeated trial and error learning, children make sense of these different worlds. They soon figure out how to understand and communicate in the language(s) they are surrounded with; and they begin developing a mental number line which will later adapt to include fractions and negative numbers. They learn which four legged-creatures are dogs, which are cats, and which are chairs without life and intention. They figure out the intentions of other people from reading into their actions or even just body language. They also learn countless things about the way objects move in space—force, speed, direction. All these areas of learning happen because children explore the world with their *whole bodies*, acting on things, interacting with people, and observing the effects of all this. Nobody needs to explicitly teach them any of this, and it isn't even necessary to have expensive gadgets or toys—any normal environment will do. Of course, you might ask, we expect our children to learn a great deal more than all this, from quadratic equations to Carnatic music. Don't we need special environments and explicit teaching for this? Absolutely we do, so we invented school—but we forgot that children's brains, whether in school or outside, retain the same capacities to learn best from multiple concrete experiences!

In stark contrast to the real world, a classroom is very restrictive and affords so little opportunity for acting upon the world. Children sitting at desks in typical classrooms are expected to passively absorb what they hear or see on blackboards, posters or textbooks. They don't get to handle things, and are in fact expected to be silent most of the time. Many of the avenues usually open to a young learning brain are blocked. Teachers who realise this try their best to make their classrooms richer in terms of a variety of experiences for their students. At the governmental level too, there has been recognition of this need. The National Curriculum Framework of 2005 expressed it clearly:

*Children learn in a variety of ways—through experience, making and doing things, experimentation, reading, discussion, asking, listening, thinking and reflecting, and expressing oneself in speech, movement or writing—both individually and with others. They require opportunities of all these kinds in the course of their development.*

The *Sarva Shiksha Abhayan* allots a small fund for each government primary and upper primary school teacher to purchase concrete materials that enhance learning, including globes, blocks, rubber tubing and sticks for making polygons, and so on. So although we have taken children out of the real world and into the classroom, we are bringing in select materials that we hope will fulfil their need to learn through interactive experiences. Some are well designed, as for example material that allows you to play with exact fractions and put them together to make other fractions, wholes, and improper fractions. Some are particularly useful, such as models of molecules and maps. Materials like these teach children concepts that could not possibly be deduced by them simply in an open exploration of the real world. Similarly, 'raw' materials such as tubes and sticks allow children to explore the geometrical properties of shapes that are not easily found in nature.

Here I would like to highlight two TLMs for their immense learning value: the world of nature, and the world of other human beings. To allow our students to interact more freely with both worlds, we have to take them outside the classroom—there is no substitute for this. To 'use' nature and other people as TLMs means to structure children's interactions with both, to go beyond their spontaneous, playful interactions. Here are some examples of how my colleagues and I have done this.

We are blessed with a campus in natural surroundings, far outside the city. It is a landscape of boulders, trees, grasses and paths that wind around everything before looping back to where you started. The children quickly gain as much or more comfort in the wild spaces as they do in the classroom. Their free play time is spent outdoors, in addition to which we teachers plan several specific, structured engagements with the natural world. For example, students do close observation of plants, insects, lizards and make very detailed drawings. They learn to draw what they see in front of them, rather than from their stored knowledge or imagination.

They grow vegetables in patches that they maintain through the rainy season. They go on walks, learn to climb trees and rocks, and learn to navigate using these as their trusted landmarks. Through such activities, students have questions about what they observe, and we take time to elicit and record these for everyone to consider. For example, *How can you tell a weed from a plant? How fast does the bamboo grow? Can we tame a bird in the wild? When will this rock fall down? And How did the centipede die?* Over the months, we figure out with them how we might investigate these questions. We encourage them to make guesses based completely on their own observations, and we do not refer to texts or the internet for any answers. These activities in our perception most closely match the way children learn in real world environments.

In older classes, our use of nature as TLM becomes more formal and rigorous. Courses in biology, environmental studies and geology can access the immense outdoors as the laboratory! Senior students can quickly 'download' information from textbooks and teachers, but we hope the spirit of investigative learning and hypothesis-generating is still alive. And young people who retain a close and affection contact with nature are so vital to the future of our planet. A teacher in a city school can take his students on short trips; maybe to a beautiful grove of trees just a half-hour walk away, or a park nearby. Schools already do trips like these, but the way their time is spent in these beautiful places needs to be re-imagined.

What about social interactions as TLM? In typical classrooms, the child's natural inclination to socialise is frowned upon: don't talk to your neighbour, don't talk out of turn, work alone and don't help each other. All these rules can be relaxed if we have smaller class sizes and more flexible teaching styles. We must allow classrooms to be noisy discussion spaces for some time each day, and we must encourage students to work together in pairs or small groups. The benefits of all of this are well documented, yet what prevents us teachers from making it happen is partly our fear of losing control over the discipline of the class. If we realised how important these social interactions are to our children's learning and development, surely we will find ways to change classroom cultures to become more interactive, without becoming dysfunctional!

My colleagues and I make every effort to encourage students to engage with people in various learning contexts through the years. Social science and language classes are essentially all about human interaction. There are plenty of well-written books in these subject areas, and reading can give children a window into the world of other people; but nothing beats the immediacy of a face-to-face conversation. So whenever possible, we take small excursions outside school for students to meet and talk with people in the neighbourhood. Language classes often include interviews with family members or residents of the nearby village. Children have made 'Day-in-the-Life' booklets about a variety of people: ice cream seller, traffic policeman, *mochi* and auto-rickshaw driver. When we learn about the history of Bangalore, it always involves a few precious conversations with elderly people who have lived and worked in the city for decades, and who remember the old days with vivid clarity. We have found that people from all walks of life are happy to talk with children—we have never yet been told we are being a nuisance! What the children understand about these lives is documented in illustrated booklets, and added to the school library.

Nothing can substitute for direct interactions with natural processes and with other people. We have to change our ideas about traditional classrooms to allow for these interactions, and I feel there is already a recognition of this among many educators and teachers. Progress is definitely happening...but recently I read something that made me wonder. It was an article[1] about an educational breakthrough called Connected Worlds (currently installed in a museum in America), described as 'a cutting-edge installation that aims to teach youngsters about environmental science by immersing them in it.' Immersing them in what? Well, a digital, virtual environment complete with animated waterfall, animated forests and creatures, and the computing capacity to respond to children's actions in this environment. The article states that children learn better when they see the connection between their actions and what happens in the environment, and that this does not happen easily in a classroom. It ends with this cheerful thought: '...the best thing we could hope for is that, a decade hence, an educational environment like Connected Worlds will seem totally ordinary.' Sometimes, I worry that we are going to go straight from classrooms to virtual worlds!

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[1]*https://www.wired.com/2015/08/key-digital-learning-bring-real-world/*

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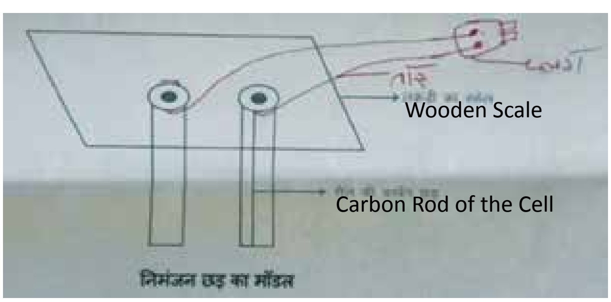
# TLMs in Teaching of Science

**Anju Sharma**

Under the present scenario, pedagogy demands our consistent effort to evolve scientific teaching methods. It must involve the use of scientific tools or Teaching Learning Material (TLM) without which neither teaching nor learning is possible. In this article, I will talk about the experiences of my life as a student as well as a teacher and also share my understanding that changed in course of time.

When we were students, the teacher was the most prominent person in the school. Along with a textbook, at times, some additional material was also used during teaching. I remember the day when our science teacher showed us a chart as a TLM while teaching the organ system of human body and how we enjoyed the class and drew pictures looking at that chart! I still remember the model of immersion rods that we had made with materials collected from our surroundings.




*Model of immersion rods*

The model shown above would heat a mug of water in a few minutes. We remember this model vividly because we had made it ourselves.

There used to be a lot of talk about teaching-learning aids and we used to make them painstakingly but did not know their proper usage. Most of these aids did not have any involvement of learners, they were there only to show and tell. The students did not have any opportunity to have hands-on experience. During my school days, the teachers neither brought TLMs to the class nor did they spend too much time in making them.

In 1997, I started teaching science at a non-government aided secondary school in Udaipur. I was to teach science to classes VI to X. Initially I started explaining concepts using the blackboard and chalk and felt that teaching with the help of a textbook was a pretty good idea. A workshop for science teachers was held in winter vacation with science teachers from some other schools affiliated to our institution also joining in. In the workshop, we performed many experiments in science and had group discussion on them. We understood things better and that inspired me to use TLMs on a regular basis. It further made me realise that the science I had studied earlier was based on learning by rote without understanding the concepts.

In one of the experiments conducted in the workshop I saw how a coin placed in water appears to be raised and what changes occur when water is poured or removed from the container. Many things got clarified after this observation. This experiment was very much there in the science textbook of class 8, but Until then it was not clear to me as to why the coin looks raised in water: when I saw the experiment with others colleagues in the workshop I was thrilled! We had not read this experiment properly till then and that day I saw it happening. After that I started performing experiments given in the book on my own and my confidence increased. We also conducted experiments in our laboratory and the children understood the concepts better. During a science evaluation we observed that the children could answer questions in a better way since they had learnt the concepts by performing experiments. Their performance, drawing (labelling) and expressions were quite explicit.

We also observed something very important while performing experiments (given in the textbook) with the students. Our results of about ten experiments from the science textbook of classes 6-10 of Rajasthan Board did not match with the textbooks results. Now, I do not know whether we did not read the instructions properly or we went wrong in performing those experiments but the fact is that the results did not match though we conducted them many times. Some examples are given here:

1. The cover effect of the magnet – According to the textbook, if iron filings or small pins are kept on small thin sheets along with other small items and a magnet is moved from under the sheet then the iron filings or small pins would also move with wood, plastic fibre, glass etc., along with the magnet. However, they would not move at all when the magnet is moved from under the iron sheet kept on the thin sheet because the magnetic field cannot cross the iron sheet. But when we did the experiment in the classroom using geometry box as an iron sheet, we found that iron filings or pins did move a little.
2. Air applies pressure – The book says - take a tin or a cask half filled with water and heat it. Put out the flame once the boiling starts, close it with a lid and allow it to cool. After a couple of hours, the cask was shown to have dents here and there. But when we actually performed this experiment in the laboratory there were no dents on the cask. We started using transparent plastic water bottles for this experiment. This experiment is now done with plastic water bottles even in the textbook.

I also realised that preparation of kits and TLMs often take a lot of time. Many a time it is argued that since the kit is not available experiments cannot be conducted. I can say with my experience that many experiments can be done with simple materials. There are three categories of materials.

I. Materials available around us. Some of them can be found in school itself. A lot of experiments, observations and studies can be done with such materials.
II. Teachers and children can bring certain materials from home.
III. Materials can be bought for the laboratory or class.

I also feel that the added benefit of such material is that it opens a possibility of some experimentation and discussion at home also.

In 2014, I started teaching in Government High School, Gingla. Gradually I started conducting experiments there also. When I taught separation of substance in class 7, I told the class that in order to separate a mixture of two liquids that do not mix with each other (for example mixture of oil and water) we can use the empty glucose bottle used in the hospitals instead of a separating funnel.

There was a government hospital in front of our school. The very next day children brought an empty glucose bottle from there, cut the top slightly, got some oil from the school kitchen and mixed it with water. It was allowed to stand for some time and then they were separated using a stopper. Whenever this question was asked for evaluation, the children answered it by drawing a clear picture and I concluded that when children collect the material themselves they understand the concept very well. The whole class is full of enthusiasm and energy when such an activity is assigned.

Similarly I took Class 6 students to the school garden to study types of plants and their parts. I wanted to tell them about transpiration which is the process of water movement through a plant and its evaporation from aerial parts, such as leaves, stems and flowers. The students were asked to place a clear plastic bag over the leaves and tie the bag loosely with string around the stem. When they opened it after five hours I could see a miracle happen! The children who never spoke in class were also answering my questions! Here is an example of the dialogue we had that day:

Teacher - What is seen in plastic bag when it is opened?

Children - Water drops. Madam, the leaves are also wet.

Teachers - Where did these water droplets come from?

Children - From the leaves, from the plant.

Teachers - Do these drops come out every day?

Children - Yes.

Teacher - But why do we not see them?

Children - They vaporise due to the sunlight.

Teacher – From where did the water come in the leaves?

Children - from the roots.

Each child also drew a diagram showing transpiration in plant.

My experience tells me that in order to make science simple, interesting and child-friendly, we have to collect materials from around us and give opportunities to the children to do things for themselves to make learning happen.

Most teachers do not use TLMs while teaching science in schools. Only a few use them on certain occasions depending on their interest. The lessons do talk about conducting experiments, but there is no clear demand anywhere. Some schools have TLMs but the teacher is not interested and in some other schools the teachers are interested but there is lack of TLMs.

One can procure the materials required to do the experiments given in the book and start conducting them. Some are easily available around us, some can be got from children's home and certain other necessary items may be bought from the market. TLMs, according to me, are not about some purchased readymade materials. It is about a 'science kit' for the students which can be used by groups of students of many classes to do experiments along with reading a textbook.

Therefore, a well-thought-out kit provides a practical form of science teaching. This develops scientific thinking in the students, giving them an opportunity to 'learn by doing'. The students become energetic, understand the concepts and arrive at their own conclusions thus enhancing their confidence.

*This article was originally written in Hindi. It was translated to English by Nalini Ravel.*

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# TLM-An Obstacle or an Advantage?

**Ankit Shukla**

In the educational fraternity, we commonly use some terms such as pedagogy, learning practices, etc. The thing which is to be discussed as of now is a special word known as Teaching learning Materials or commonly known as TLMs. What does the word TLM? What is its utility? If I go by the definition of TLM, it means any aid that assists in teaching and learning of students may be categorised under this definition.

The common misconception is that TLMs must be made by teachers only and must be used by students in order to understand a concept. I too thought this - that because a teacher knows the topic well or he/she has an expertise, only he/she could create opportunities for the students to understand it much better. But very soon, I had to change my beliefs.

An incident made me do so.

In the Fellowship Framework, I had to go through a School Understanding Programme (SUP). In this, I had to continuously observe a specific school over a period of time. So during my observation period, I was observing a class 5 maths lesson. The teacher was talking about number line on which numbers are placed. There were some students who were not getting the point - they could not understand it. Though the teacher was explaining it again and again. After few more attempts, he just moved on.

The next day, there was a student who came with a straight wire having some loops that he had got from his father. He told the teacher that this wire resembled the number line, where the loops may be treated as numbers. The teacher was amazed to see it and used it in the class with a little improvisation. He just placed some number cards on the loops with help of cellotape. Now the students could clearly visualise the number line and do some basic operations like forward, backward, jumping etc. with the help of this TLM. So this incident clearly acted as a myth buster to me.

**TLM as a visualisation aid**

Now this is from my time as a teacher. Teaching was also part of my fellowship framework. During my transaction period, I was transacting a particular theme -Time Measurement planned for class 5. I was discussing the ancient time measurement techniques. It included using sundial, water clock, sand clock etc. The students were able to get the concept, but it was very difficult for them to visualise the actual instruments.

To make it easier, I decided to develop one of them with help of the students. We decided that we would make model of sand clock. As the first step, we made a list of the materials required: two plastic bottles with caps, Fevistick and sand. The students volunteered to bring the materials.

The next day when I went to school, the students were very excited. They showed me the materials. The sand was not fine enough and had to be filtered. I asked a student for a sieve. While I was talking with some students, I observed that one of them just went outside, found a small bottle of very soft plastic. He took a bottle, made a hole with help of stick and then started filtering sand. Though the size of the holes made by stick were very big and filtered sand was not as fine as required, I was startled. The idea was brilliant - you never know the level of creativity in students.

After filtering the sand we just made a hole in the bottle cap and joined the cap of bottles with help of the Fevistick. The sand was flowing from the top bottle to the bottle below. Students were now able to understand/visualise the method of measuring time. One cannot imagine the joy and happy which they felt during and after making of sand clock.

**TLM as a concept clearing tool**

We were once again dealing with the same topic in the same class, but this time it was the subtraction of time. Students were facing great difficulty when they had to subtract by 'borrowing' from minutes: for example, subtracting 3 hours 59 minutes from 5 hours 55 minutes. So, to deal with this I used popsicles. I asked them to make the bundles of 60. They were so thrilled that many of them made more than one bundle. Now getting to the problem: the bundles were placed in the hour column and some loose popsicles were placed in the minute column. When they had to 'borrow' from the hour column, they could clearly see that one bundle equals to 60 minutes and now they could solve the problems very easily.

Earlier, the students were not able to visualise that one hour equaled 60 minutes. Some solid demonstration, which they had done themselves, made the concept very easy to understand. Once they did it with the popsicles, they understood the concept behind that activity. Now they could easily do the subtraction without the help of the popsicles.

**TLM as a learning assessment tool**

The next TLM which I am going to discuss may be used in much lower classes such as classes 1 and 2. This activity may be used for assessing whether a child has learned number recognition. .

Some beautiful coloured photos, which are present in the children's surroundings and which they find attractive were printed and laminated. Then, the pictures were divided into ten parts with the numbers 1-10 written on each. The students had to arrange the numbers to complete the picture. With the help of this TLM, a child will feel like making some new thing. Also he/she will be curious to know what image would appear.

With this activity a child's learning can be assessed in a very attractive and interactive method instead of the usual paper pencil test. Actually what usually happens in classroom practice, is that the teacher comes, scribbles something on the blackboard and students shout in a chorus - 1,2,3…. without understanding the meaning.

During an interaction, a teacher once told me that earlier he used ignore TLMs and his pedagogical practice was also very ordinary. But after attending a workshop he realised that each and every thing he sees could be used for TLMs. He told me, 'Wherever I go, I see TLMs. During my morning walks, I collect smooth stones. In restaurants, I collect paper plates. In ice-cream parlours, I collect sticks. These things which I collect had helped me in my classroom transaction. Now I have realised that my pedagogical practices have improved'.

On the other hand, TLMs have limitations. The problem lies in using the TLM: when a teacher depends only on TLM it is just a medium of getting the concept. But sometimes what I have observed is that teachers are very much governed by TLMs and they do not get into the concepts.. They must be used, but the underlying concept should also be discussed. They are the journey, not the destination. Also, TLMs become more effective when the learners are involved in the process of creating them. Learners too may identify the limitations and advantages of TLMs. This is not solely the responsibility of the teacher.

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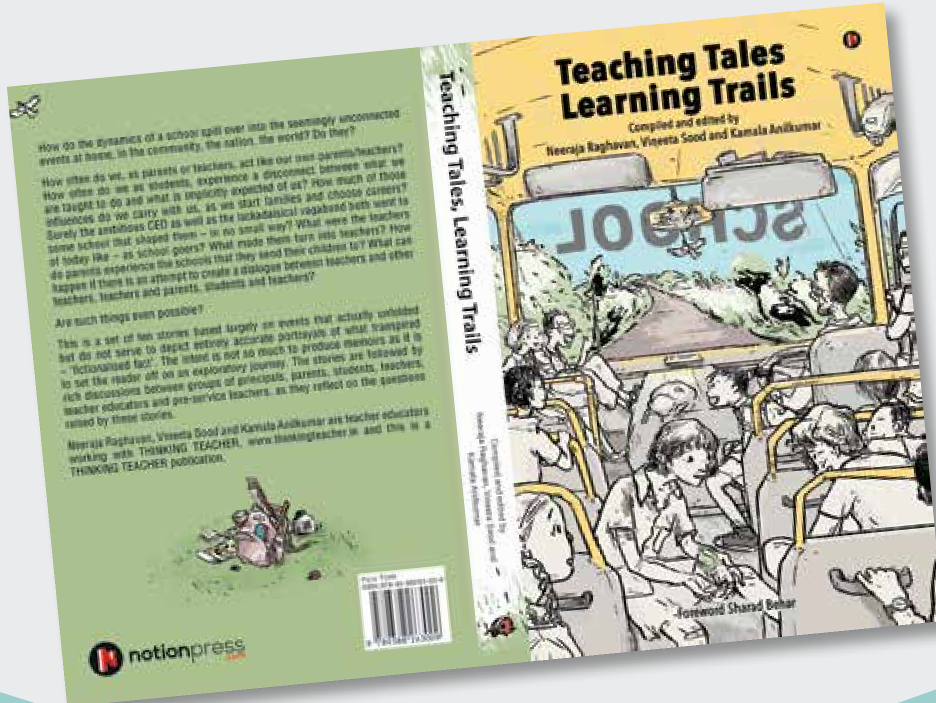


**Teaching Tales Learning Trails**

Compiled and edited by **Neeraja Raghavan, Vineeta Sood and Kamala Anilkumar**

## Book Review

**Dr S Anandalakshmy**

The contribution of this book to the available tomes on education is unique. It presents many of the issues that arise in any school: the expected focus on examinations, methods of correction of student assignments, the inevitable staff meetings, inclusion in the classroom of children with special needs, the Principal's role in mentoring the teachers, supporting the talents and interests of all students and so on. Each theme is handled differently; one of the cases is presented as a teacher's confidential diary entries, another takes the form of email correspondence between the parents of a child, where the father is out of the country and the third is a dialogue between a child and the Counsellor. These strategies help the writers to be candid and to be treated as insiders in the episodes. Understandably, almost all of the narratives are fictionalized, but the ring of real life is a constant.

Comparing children, be they siblings, neighbours or class-fellows on appearance, talents or school performance seems to be so common in our culture, that people are not aware of how comparisons are frequently odious. Sometimes, unfavourable comparisons leave a scar for a lifetime. A stereotype tends to cling.

Children with special needs or special gifts pose a threat to teachers who prefer uniformity in class room performance and behavior. This aspect is also raised and resolved in a couple of narratives.

The second part of the book, "Learning Trails" finds the episodes in Part I discussed at length by selected groups of students, parents, teachers and principals. To begin with, the authors of the book have a variety of impressive academic credentials. And the persons they invite for the discussions are all articulate, introspective and candid.

Although some of the vexed issues about the processes in evaluating children are raised here and there, including in the Foreword by Sharad Behar and in the questions of a new Principal on feedback mechanisms of student assignments, the school systems in India do not have a workable formula on what to examine, when and how often, how to standardize the evaluations at relevant stages and so on. Some sought-after courses and institutions make their own entrance tests, resulting in the sprouting of coaching schools by the thousands to help aspirants to tackle them. As for any method of acknowledging a student's original and creative thinking, within the parameters of an examination system, that's another country!

All the actors we meet in these pages are more than well-versed in the English language: they are fluent. And the world they inhabit is of well off families who seek high-fee paying, well run schools. So the much-touted 'medium of instruction' is an invisible factor here, or to use a current expression—is the elephant in the room. For the large majority of Indian school children, "English medium" is a magic wand. Classes in spoken English are expectedly much in demand, but viable ones are not easily available within or outside the school. Perhaps, students who have mastered the language should be conscripted during the summer vacation to help the English communication skills of other students. It's a quixotic thought, I will admit.

In a world dominated by mobile phones and a burgeoning variety of gadgets, I hear that reading books has become a rare activity for young people around the world. I know of no method other than reading voraciously, to acquire the idioms and usages of a language. This, for the millennials may be the road not taken.

I would like to end this brief review by felicitating the team of authors. They have collected and packaged everyday school experiences with sufficient detail to endow them with an authentic feel.

To the reader, my advice is to savour this volume. If you are a speed reader, it helps!

This book can be purchased online at: https://notionpress.com/read/teaching-tales-learning-trails

Preview of book: https://thinkingteacher.in/teaching-tales-learning-trails/

Kindle Ed: https://www.amazon.in/dp/B07GK4JQ4G

**Dr. S Anandalakshmy** took her degrees from Madras University, Bryn Mawr College and the University of Wisconsin. After a short stint at heading Vidya Mandir, a school in Chennai, she worked at Lady Irwin College (Delhi Univ.). She developed and established the master's degree course in Child Development and later headed the College. She has travelled widely for conferences in the USA and the UK. She has worked in an advisory capacity in many NGOs, including Mobile Creches in Delhi and SEWA in Ahmedabad. She may be contacted at anandalakshmy@gmail.com

# My Tryst with TLM

**Bikash**

In my last five years in education, I have had opportunities to visit a spectrum of schools across the country. Visiting a school run by a welfare trust catering to tribal children in Majuli to exclusive schools catering to elite in Mumbai – the range of schools I saw gave birth to a number of questions in me.

I was surprised witnessing the inequities in terms of access to school infrastructure, teacher quality, curriculum and learning resources. The exposure to realities made me patient to witness more of these in my country and reflect on what I can do within my capacity towards making things more equitable.

It was a time when I was working with Pratham Education Foundation. I was part of a team in Assam setting up education technology infrastructure sponsored by a telecom giant. Apart from setting up infrastructure, our objective was to improve the teaching and learning practices in the school

The system we introduced to schools essentially targeted to make teachers 'guide by the side' rather than being 'sage on the stage'. The digital tool enabled the teachers with adequate content in alignment with their syllabus and, most importantly, gave them step-by-step instructions to design a teaching learning material for their lesson. It was indeed inspiring to see teachers putting in effort to create the learning tools for their class and the most motivating moment came when the students participated in the process with the teacher being in the role of facilitator or being a *teaching leader*.

In this piece, I will be sharing two cases in brief: one of a teacher from a private aided school in Dibrugarh and another one from a government school in Mumbai

At Rastrabhasa School in Dibrugarh, Assam, the teacher partnered with children to experientially learn about seeds and germination by practically doing it in their classroom. The teacher had announced in advance his plan for the lesson and had given children adequate time to bring at least one type of seed. He instructed students to plant the seeds in soil which was placed in small quantities in half-cut plastic bottles.

As the time for lesson approached, he had ready a set of saplings at various stages of growth. On the first day of the class, he got all those pots in front of the class and placed them on the table. All the students were excited and engaged – They had so much ownership of the class that there was a curiosity commotion. I saw two students sitting next to me chit chatting with each other and saying if they had brought a fastest growing seed, then today they would have a tallest sapling. One student was not able to hold his disappointment and asked the teacher why his plant has not grown yet even though he watered it daily.

After conversing with the child whose seed had not germinated, the teacher patiently started his class. He was clear with the objectives of his class and students were ready to learn about plants.

The class started with a three minute video explaining the process of the growth of a plant from the seed stage to a small sapling, using a time-lapse video of the process. The students were happy to see the complete process within a span of three minutes. However, the video made many students question the teacher about what seed was that which grew so fast? The teacher had later to clarify about the time-lapse videography and the growth was shown in such a brief time. The class was pretty amused to learn about the process of making of the video.

After the visuals, the teacher asked whether they had recorded their observation of their respective seed. Most of the students had recorded their observations. As it was a big class the teacher focused on collecting all the notebooks first to review them later in the day. The student whose seed had not germinated was hesitant to come forward but the teacher encouraged her to submit her notebook.

The teacher arranged all the pots in a line so that all students could see the presentation clearly. He asked students what they could see and to share their experiences – right from selecting the seed to preparing the pot with soil in it. The classroom participation took me by surprise – it was filled with enthusiasm, eagerness and seeking to learn more.

The learning that had taken place was that students now knew about the types of seeds and the conditions required for a seed to germinate. They explored on possible reasons on why some of the seeds did not germinate and the possible next steps they could try to observe whether it would germinate. The teacher supported the students with appropriate information on right conditions for growth.

The class summed up with a lot of satisfaction as well as enthusiasm, with students moving about and there was chatter about the next steps. The teacher quickly reached out to the child whose seed had not germinated at all. He looked fine after the class as he had got the answers on why the seed had not germinated. He was motivated and eager to try again and give right conditions to the seed to germinate.

Later in the day, I met the teacher to reflect on his class. When I asked him how was the class, he replied back with a diligent smile and said, 'It was effort by the students themselves, I was just a guide and gave some instructions'. I was delighted with what he said and I applauded his efforts in the meticulous planning for the lesson and the timely, specific and clear instructions to the learners. He consciously valued every minute of the time he had with the class for classroom instruction.

This classroom observation was in itself a learning powerhouse for me. I had earlier heard of teachers who would go the extra mile to ensure learning. I had heard of teachers who had received recognition at national level for their consistent handwork. But this was the first time I had observed a class by a teacher who was indeed extraordinary and a champion to both the children and me.

In 2015, one of our partner school teachers was recognised as Teacher Innovator for her efforts in enriching classroom experience through her innovative teaching learning tools. On *Saving Electricity* topic, she asked all of her students to get their electricity bills for three consecutive months. And this was how lesson on saving electricity was imparted. The data collected was to help visualise the units consumed and amount charged and how could they save both electricity and money. Discussion on how to lower energy consumption at home was led by the teacher in the classroom. Every month students compared with each other whether their actions on saving electricity at home led to less unit consumption viz-a-viz decreased electricity bills. The teacher found this exercise impacting student learning and she was happy with the students applying their learning to solve real life problems.

In both of the above cases, the use of teaching learning materials or aids were of the low-cost or no-cost nature; however, they did require a certain amount of pre-planning and a robust execution aligned with the lesson or curricular objectives. Sometimes when the objectives of lesson seems vague planning or outlining a plan for effective learning loses it way. Thus it is important to first gain clarity on the objective of the lesson and then finding meaningful ways to teach.

I feel the journey towards using a teaching learning material for effective teaching starts with the objective of the lesson. Once the clarity on the objective is gained, it is easier to plan the materials and aid for teaching. Some tools might be easily available some time will need some brainstorming. A simple material like the electricity bill, kitchen waste, measuring tape among others can be used for different lessons.

Teaching learning materials and aids help to cater to learners with different learning styles and make the process of learning experiential.

**Bikash** is currently working with Vikalp India, a social enterprise implementing experiential mathematics curriculum. He started his career in education with Pratham Education Foundation after graduating from Azim Premji University. He may be contacted at bikashbhandary.chetry@apu.edu.in

# TLM – The What, the Why and the How!

**Chandrika Muralidhar & Ronita Sharma**

As teachers who have been in classrooms for a close to two decades, this term Teaching Learning Materials did sound alien at the beginning. It did lead to very fundamental questions. What is a TLM? Should we use it? Do we use it at all in our teaching without actually knowing that we are using it? Is that possible? How do we use it if we are given one? Are we resistant to the idea of being handed a material which we do not know how to use or do not want to use? There could be a lot more such questions and what we will be doing here is to present our understanding of such materials in Science and Social Science - some that we have used and some that we have watched others do so effectively

What would constitute a TLM for a teacher who teaches mostly higher secondary classes and maybe a couple of secondary classes? It would be anything that would help to put across a concept in Science/Social Science such that the students are able to comprehend it, analyse it, draw inferences, apply it and also hopefully draw connects with other related concepts. Would it be too ambitious to expect that the material nudges the student to think beyond what is being discussed and probably provide a path to further exploration? Probably not, is what we would like to say. So, it would be a material that would support us in achieving the objectives designed while teaching a certain concept. We deliberately use the word 'support' as that is what it is to us as teachers. It would help to illustrate the concept being discussed and also to reinforce any idea being presented. Our classrooms have children with varying capacities of comprehension – some are visual learners and other could be auditory ones. So the material used should aid the pedagogy that is used by the teacher in her classroom and also to nurture the student's understanding of the concept. Another very important aspect in the use of the materials should be about the learning experiences that it provides to the learner which in turn would reflect in the learning outcomes of the class as a whole.

Let us now consider a novice teacher and her preparation for classes – what does she have with her as a starting material – one would think the unanimous answer would be: the textbook. This takes us back to a discussion with a dear colleague and co-teacher and the role that a textbook had to play in her classroom. She would say :

a) it is a major part of the teacher's 'armoury' with which she enters a classroom - meaning it provides her with a certain level of confidence – it's a tool that she relies on

b) it is also the one 'common connect' that she has with her students

c) with its presence she can be on the 'same page' as her student

d) it is a great leveller

e) it provides a framework for the prospective pedagogy to be used in the classroom

To be very honest, the textbook was the very first TLM that was provided in the early teaching years and it did provide a direction towards the syllabus of the subject as that was not a document that had an easy access. So is a textbook 'the TLM' or is it a part of the many materials that are available to be used?

Let us see what the National Curriculum Framework 2005, Position Paper National Focus Group on Curriculum, Syllabus and Textbooks has to say about TLM:

'What is needed is not a single textbook but a package of teaching learning material that could be used to engage the child in active learning. The textbook thus becomes a part of this package and not the only teaching learning material'.

Having spoken a little bit about *what* could be a TLM, let us see why one would need it. Earlier we have stated its role in the classroom teaching learning process. Is it necessary at all to use a material in the classroom? What would categorise as a material? Does it need to be a readymade packaged item or can it be as simple and yet very effective as board and chalk? As a teacher who taught Chemistry for a decade and half, without a textbook, the preparation for the class was based on the detailed syllabus available as reference. So the very primary material, the textbook was not available. This led to creating a very basic kind of material which were detailed notes and even more detailed unit plans. Some other materials which made their way in were flash cards and worksheets (on numbers, balancing equations, filling in steps of processes etc). In this case the materials created were based on their requirement to fulfil a certain kind learning objective and also the pedagogy used (as mentioned earlier).

As to how a material finds its way into the classroom, there could be different views. For a motivated and committed teacher a material is not a showpiece but something that adds to her already existing planned pedagogy. It is something that makes her classroom teaching effective, keeps her students engaged and supports learning. Hence it is extremely important to define the purpose of the material being used for the process of teaching and learning. Let us consider an example. The Modern Periodic Table is a very important part of school Chemistry. Most textbooks and many classrooms have a model of this. This could be a resource that can be used throughout the year whenever elements are referred to and not just when the topic of classification of elements is being taught. It is about discovering an element in the table, its position, its properties and the implications of the position of the element. Another example would be the use of the science lab – a non-existent entity in many schools – a lab with basic materials would be a wholesome teaching learning material for many concepts. Hence, the purposeful use of a material is in the hands of the teacher, her vision of choosing the appropriate material and its use in her classroom.

**Animating textbooks in the Social Science classroom**

Going back to our social science classes among the other things which comes to our mind is the textbooks where the teacher would ask the students to read paragraph by paragraph and complete the chapter, underline the text, mark the answers and during the examination reproduce in the same way. On the other hand remembering my English teacher who could use the textbook to the maximum. At the end of the term our books would have pencil marks, annotations, summarising, paraphrasing and identifying simile, metaphor, a pun, sonnet and so on. It was just like traversing the whole textbook with joy, excitement and cognitive enrichment. So till now I was mentioning the textbooks which were designed 30- 40 years back. A teacher had the capacity to make that textbook lively and interactive even then. A textbook which would speak to us, interact with us and talk to us. But why then the textbooks are considered to be boring or even for that matter not considered to be a useful TLM.

Therefore the larger question is how a textbook does becomes a useful TLM. The experience of teaching Social Science post 2005 is a significantly different experience for the teachers. Taking an example from the History textbook from the theme Everyday Life, Culture and Politics introduces us to the chapter – history and sports. In this chapter several primary and the secondary sources have been used. Through the textbook the teacher helps to bring multiple perspectives in the class and also the students are introduced to the original writing. It also helps to develop the skills among the students to interpret and synthesise various sources.

Box 1 Source A

Caste and cricket Palwankar Baloo was born in Poona in 1875. Born at a time when Indians weren't allowed to play Test cricket, he was the greatest Indian slow bowler of his time. He played for the Hindus in the Quadrangular, the major cricket tournament of the colonial period. Despite being their greatest player he was never made captain of the Hindus because he was born a Dalit and upper-caste selectors discriminated against him. But his younger brother, Vithal, a batsman did become captain of the Hindus in 1923 and led the team to a famous victory against the Europeans. Writing to a newspaper a cricket fan made a connection between the Hindus' victory and Gandhiji's war on 'untouch-ability': 'The Hindus' appointing Mr Vithal, brother of Mr Baloo – premier bowler of India – who is a member of the Untouchable Class to captain the Hindu team. The moral that can be safe-ly drawn from the Hindus' magnificent victory is that removal of Untouchability would lead to swaraj – which is the prophecy of the Mahatma.' A Corner of a Foreign Field by Ramchandra Guha

**Audio-visuals**

With the advancement in technology the latest in the line of TLM is the audio-visual. The usage of this TLM should be meaningful and relevant, otherwise it can just become a tool for entertainment. In order to run a movie, documentary and audio there should be specific purpose in mind of the teacher. It should be age appropriate and pertinent to the theme. Some kind of preparedness is required both at the end of the teacher as well as the students before the use of the audio- visuals. This preparedness includes what they will be watching and hearing and its connection to the chapter. A graphic organiser with the list of questions to be answered by the students is one way to make them active rather than a passive viewer.

But a word of caution - overuse of audio – visuals will turn the students into passive watchers who will look for leisure time in the classroom. Let us share an instance .The teacher has just completed a chapter on ‘Hitler and the rise of Nazism’ and she has promised to show them a movie *The Pianist*. After watching the movie the students go back to their classes and the next day the teacher starts a new lesson. So in this particular scenario the teacher has used the audio –visual as the TLM. Was the students’ learning experience enhanced by it? Maybe yes or maybe no. At times the pressure on the teacher by the Management and peers in high end schools forces the teacher to use technology just for the sake of making her class appear more trendy and to enhance the prestige of the class.

**Today’s News, Tomorrow’s History: Newsprint and the Cartoon**

The incorporation of a wide range and variety of cartoons in social science books has made the text powerful and rich. The nature of the political cartoons are such that it speaks of something which is contemporary. So now, do we look it only as a sketch with funny features to make us laugh and smile or it conveys much more than that? As quoted in the Social and political life textbook one should not merely **see** the images and turn the pages but one is expected to **read** the images as very often politics is carried out not through words but images. It can be also used to hone the skills of observing, interpreting, analysing and reflecting visuals.

**News clippings as teaching-learning material**

A very interesting way to generate interest among the students is bringing newspapers to the classroom. It is also in one way to initiate the students into reading newspapers. It can be used for knowing something from the past to something which is contemporary. It brings in a lot of rich and varied discussion in the classroom and helps to build a connection with the classroom and the outer world and make meaning to the topic which is taught. The catch here can be that we need to look at two or three newspapers together so that we can see that how one news can be presented in different ways.

To conclude it is not the inherent ***quality of a material*** which makes a TLM, ***rather the use of the material*** for teaching and learning in the classroom makes it a TLM. So considering the textbooks as something which has not earned well reputation can become an effective teaching -learning material and something like models, charts, video clippings may refuse to ignite any meaningful learning in the classroom.

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# Experiences of Experiment-Based Instructions in Science

**Deepak Ahirwar**

## Background

This article is based on our initial efforts and experiences of making science education interesting and meaningful in a government secondary and high school. In this endeavour we started using the informal and project-based approach to make learning process attractive. Later we started using certain methods that can be called Guided Learning, which were more acceptable to teachers and were in line with their school curriculum. In this article, we compare the merits and demerits of these alternative methods on different grounds - such as the needs of the school, providing a good understanding of science and creating interest etc.

## The beginning of our work

From the very beginning our aim was that the students with whom we work in school should enjoy science and feel free to participate in the activities. We have established tinkering laboratories in four places with the aim of giving space to the creative energy of the children and to make them curious about science. Such labs work on the theory of constructive ideology, which promotes the use of methods that insist on learning by exploration. In such an environment, students need very little guidance from their teachers and can freely work on their own.

We found that the labs provide students with a space where they can be active practically. In our laboratories, students come with an idea of their own project and all we have to do is to provide them with the basic equipment they need and if they have any questions or problems related to the project, then provide minimum support by answering or solving them.

For example, a student comes with the idea of making a boat, he decides his design based on a basic original drawing. Then he arrives at an opinion by reasoning and based on a prevailing common theory as to why an object floats and which material should be used. The student initially makes a boat with a paper that floats. Next he decides to make a boat that runs with the help of an electric motor. But his boat is not able to take the weight of motor and other equipment and sinks. After this the student decides to make the boat using such a material which can take the weight of heavy things. So he makes the boat with a cardboard sheet and fits motor and other equipment in it. He finds his boat floating in water but after some time it sinks as the cardboard sheet absorbs water. After a second consecutive failure in his project, the child gives a serious thought to the problem and comes up with a solution. The next day, the child uses thermocol instead of cardboard, as it is lighter and stronger. This whole process enhances the student's cognitive skills. In this project-based process, we felt that though the student is getting a good opportunity for making things and understanding the properties of the material and he is very enthusiastic also but there is a huge lacuna in understanding the principles of science, which is to be filled up with the continuous support of an experienced teacher.

## Our experience in secondary schools

Apart from the tinkering laboratory, we are also working in some selected secondary schools where the mode of working was a little different. Our aim of working in secondary schools was to create interest in science among the students so that they can talk to each other and then freely discuss their questions with the teachers. Alongside we were also trying to encourage the teachers to use the project based method so that the students learn easily according to their environment. In the beginning, we did a great job with the students in collaboration with the teachers, but because the teachers also had the responsibility of completing the syllabus and they expected us to help them do that, some of the interest waned. Project-based teaching was helping the students to master a topic, which at times, was not in the syllabus. But one thing was sure, the interest of students had started growing through project- based education.

## Reasons for making a science kit

Working in secondary schools made it clear that if we want to work with teachers, we cannot ignore their problems. The teachers wanted the students to develop their understanding of science, but they had to complete the syllabus. This was a big challenge for us. We also checked the science kits given by the government. We did not get more than half of the things supposed to be kept in the kit and it was very difficult to use whatever little was available. Most of the material in the kit could not be reused and the teachers did not know from where to get them. So the teachers were not able to use kits even if they wanted to. We also tried to have the teachers come over to our block level tinkering laboratory, take required items from there and teach the students, but this did not work.

So we decided to make our own kit by including things that are easily available to the teachers and students. We also decided that we would make a kit for any one topic and make different kits for different topics and give students the opportunity to use the same kit for classes 6 to 10 for different principles. We also had to keep in mind that our kit should not be too expensive.

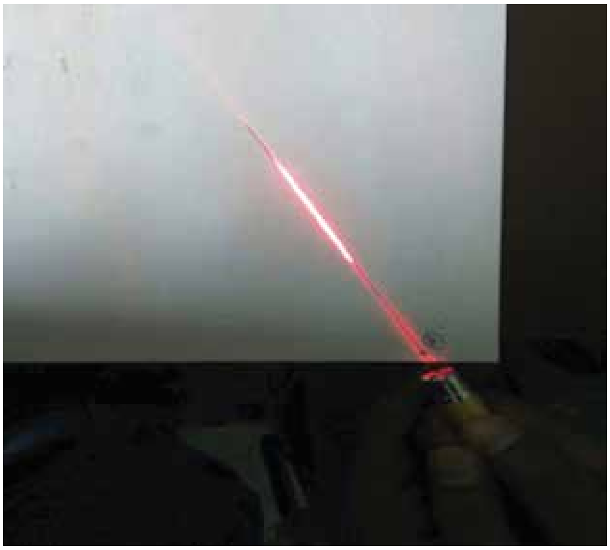
To make the kit, we selected four topics from physics – light, magnetism, magnetic effect of electric current and measurement. We created science kits for these topics and a successful demo was given in Bhopal's secondary schools. After making the science kit, they were distributed in selected schools. The teachers were given a demo and were made aware of the activities and its relation to the syllabus. They were used by teachers in secondary schools, and there is a great demand for it. What teachers liked about these kits is that even if the materials get over, they can be easily replaced either by them or the students.

Along with these kits, we have also prepared manuals to help the teachers, as well as the students as they could use the kit easily even if the teachers were not around.

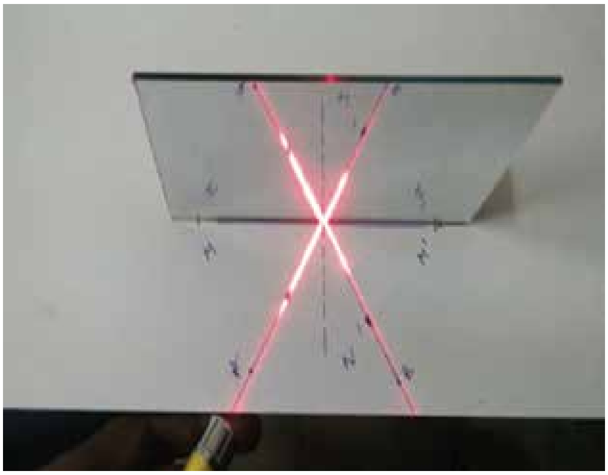
**Some important activities that could be done using the kit**

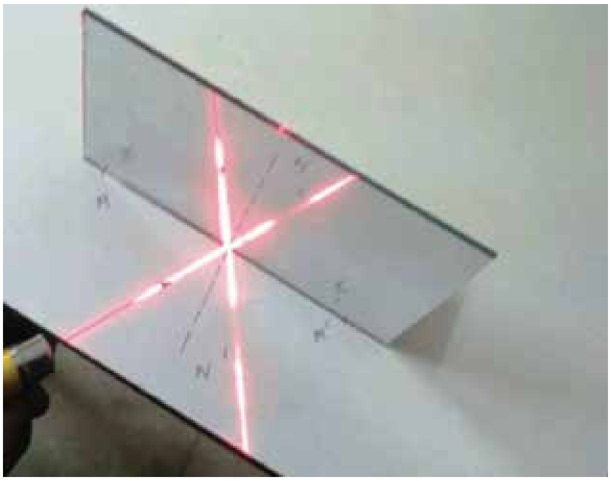
**Light –**

**Study of the path of light**

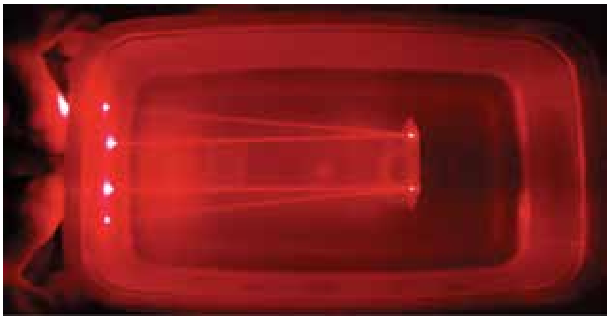


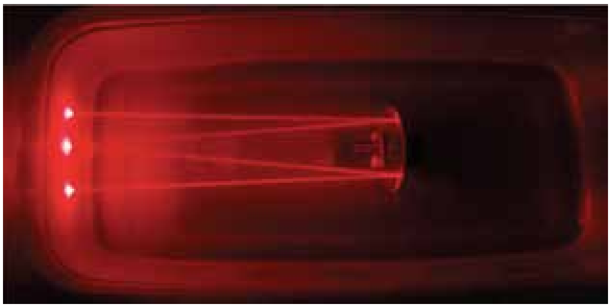
**Verification of the laws of reflection**



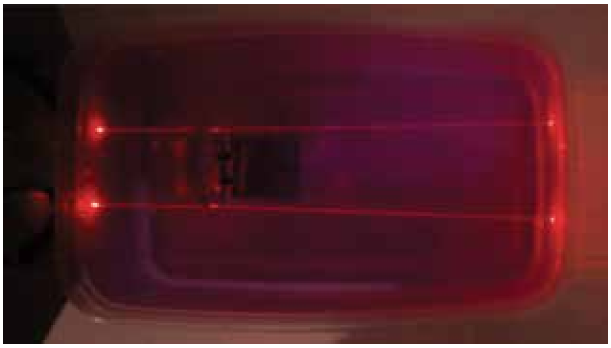


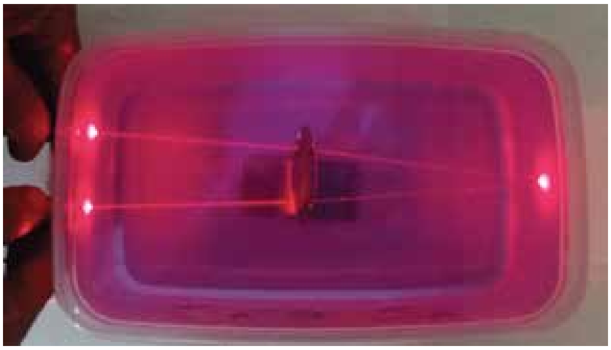
**Study of refraction of light by spherical mirror**



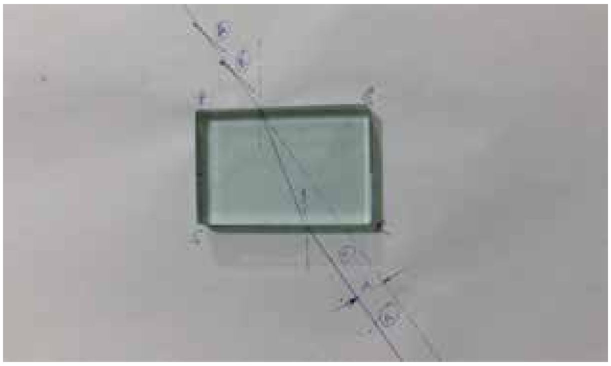


**Study of refraction of light by spherical lens**





**Study of refraction of light through a glass slab**



**Study of refraction of light through the glass prism**

**Study of dispersion of white light by a glass prism**

**Find out how many objects kept in a room are attracted by the magnet**

**Find out the nature of force between two magnets. Is gravity the only invisible force?**

**Find out whether the magnetic force is generated due the effect of electricity**

**Understand the concept of magnetic field. Study the magnetic field of different configurations**
**Equipment:**

1. One circular coil (set of 1 coil)
2. One square coil
3. Circular coil (set of 5 coils)
4. One bar magnet
5. One neodymium magnet
6. Iron filings

**Process:**

1. Mix the iron filings with water, drain it using a sieve and let it dry.
2. Spread the dry filings on a piece of white paper. Place the paper on a flat table.
3. Move some filings from the centre of the paper and place a bar magnet in their place. Now tap the paper gently. Observe how iron filings arrange themselves in a pattern.
4. Repeat the same activity with neodymium magnet. Observe how iron filings arrange themselves in a pattern.

Repeat this activity with circular coil (set of 1 coil), square coil and circular coil (set of 5 coils). Observe the pattern created by iron filings for every shape of the coil.

**Discussion**

1. What is a magnetic field?

Before understanding the magnetic field, we have to discuss the concept.

A magnetic field is the region around a magnet within which the force of magnetism acts. Although this definition is not total, it is enough to explain the concept.

2. Understanding the extent of a magnetic field

Take two magnets, A and B, and place them at the two ends of a sheet of paper. and a sheet of paper. Hold magnet A still and bring magnet B closer to magnet A. At a particular point we will begin to feel the force that is being applied on B.

Now, according to the definition given above, would it be right to say that the zone of magnetic field of A extends to the point where we begin to feel the force on B.

Now repeat this activity with magnet A and a compass. This time we may find that the force starts effect-ing the compass from quite far away and the direction of needle changes.

What can we conclude from this? We can probably say that the zone of magnetic field of A extends to a greater distance. Let us discuss this phenomenon. (Hint: Perhaps the mass of the needle is less than magnet B, perhaps the friction on the needle is less.)

If the weight of needle is further reduced, will the effect of the force on it be felt from a greater distance?

If yes, can we conclude that the magnetic field of Magnet A spans a longer distance? So if the weight of needle is reduced even further, the magnetic field of A will extend even farther.

3. What are magnetic field lines?

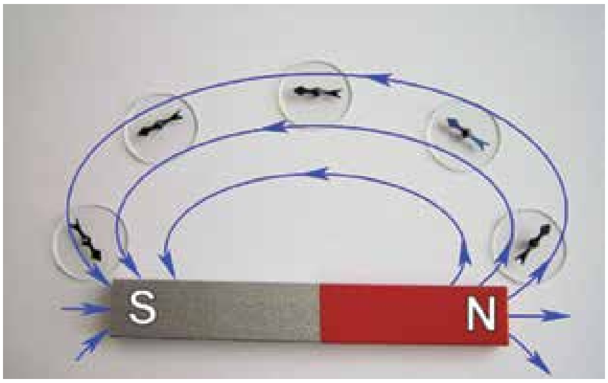
Force is a vector quantity which is a quantity that has both magnitude and direction. Magnetic field is also a vector quantity. We have two options to illustrate the magnetic field of a magnet:

i. We make a vector at every point in the field around the magnet. The direction of the vector should be according to the direction of the magnetic field at that point and the length of the vector should be according to the magnitude of the magnetic field. (Or you can also make a vector and write the magnitude above it)

ii. Or we can use magnetic field lines. Actually these lines do not exist. They only show the direction of the magnetic field at just one point, and give the quantitative estimation of the magnitude of the magnetic field at that point (it is discussed later). Actually magnetic field lines are a very rough method of representing the magnetic field. It is impossible to accurately describe the magnetic field using these lines.

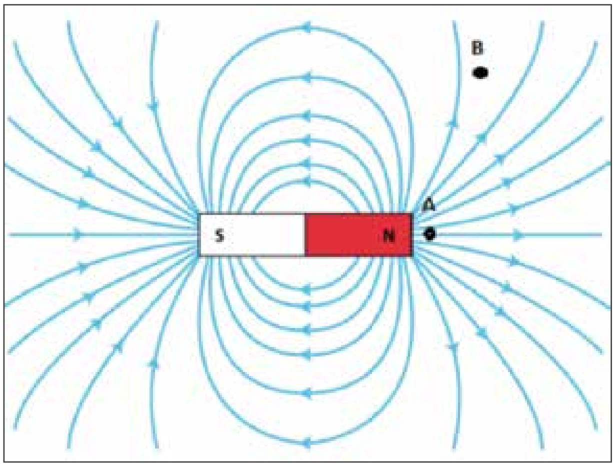
4. What is the direction of the magnetic field (or magnetic field line) at any point?

Take a magnet and put it on a sheet of paper. Place a compass on different places on that paper.



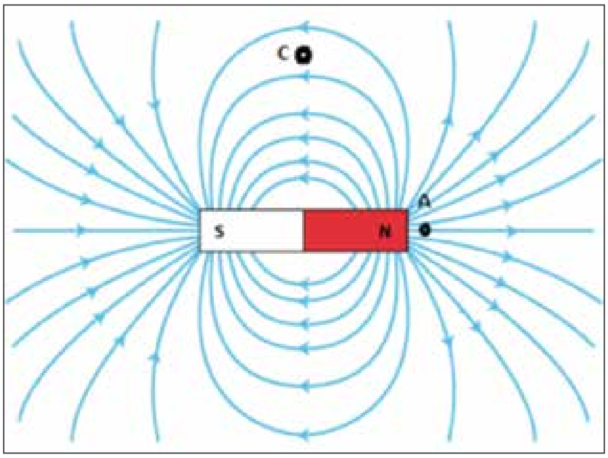

The direction of the needle shows the direction of the magnetic field (or magnetic field line) at that place.

5. How can we estimate the magnitude of magnetic field from magnetic field lines?

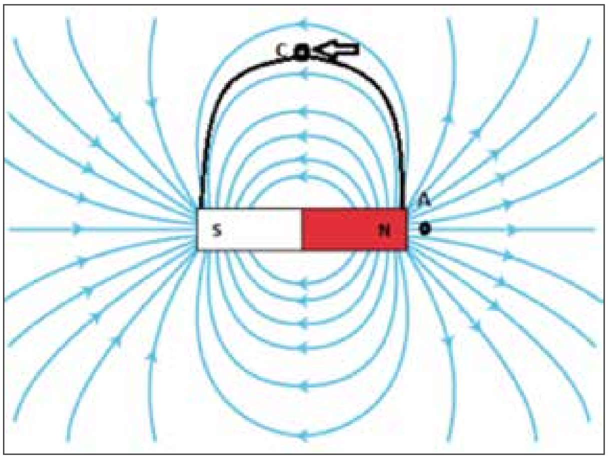



Around the point where the density of the magnetic field lines is greater than the other point, the magnitude of the magnetic field is also greater there. The magnitude of the magnetic field is higher on point A than on point B.

6. There is no magnetic field line passing through point C. Does this mean that there is no magnetic field around point C?




The magnetic field line passing through point C will look like this:



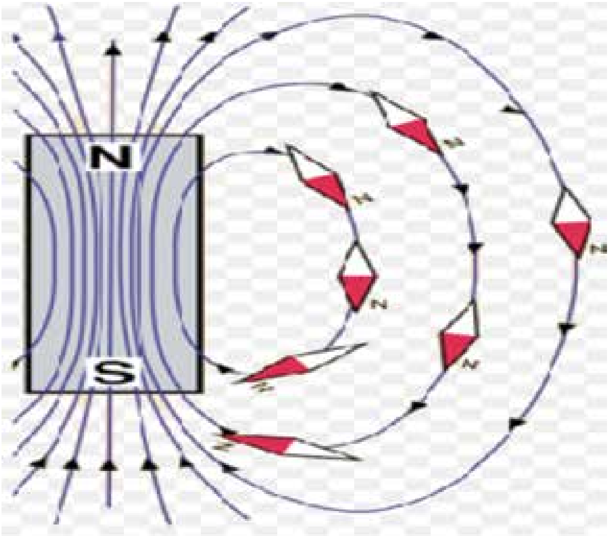

7. Some properties of magnetic field lines:

(I) Magnetic field lines start with the north pole of the magnet and end at the south pole.

(II) Two magnetic field lines do not intersect each other at any point.

(III) The magnetic field lines form closed loop.

Understand the magnetic force on the conductors Verification of Faraday's Law of Electromagnetic Induction




*The entire credit of preparing the kit goes to Dr Anwar Jafri (Director, Samavesh, Bhopal), Nitish Sehgal, (Science Coordinator, Samavesh, Bhopal) and Sunil Prajapati, (Assistant Science Coordinator, Samavesh, Bhopal). I have only written the article in collaboration with Dr. Anwar Jafri, Nitish Sehgal and Sunil Prajapati. All the experiences regarding secondary schools are my own.*

*This article was originally written in Hindi. It was translated to English by Nalini Ravel.*

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# The Blackboard as the First Teaching Aid

**Farheena Saleem**

With the changing world and changing mindsets, school teaching and learning has changed to a great extent. It is so encouraging and exciting to see that with increasing technological support and availability of information to all of us, present day classrooms and teachers have become much better equipped and there is a whole lot of zestful involvement of learners in gathering knowledge, learning skills, becoming more creative and learning at varied pace.

With most of the schools, public schools in particular, ensuring that there is a *Digi-board*, accessibility of internet, more access and availability of computers to students, the role of a teacher has changed to a certain extent. The teachers are no longer the only source of information and knowledge other than text books. Many a time, teaching becomes a challenge, because most of what the teacher is supposed to tell or explain or introduce to the learners, according to the guided curriculum meant for a certain age group ,is no longer new to them because of the easy availability of information and better exposure of the learners.

It is great to see that schools and teaching is gradually becoming more student-centric and the use of technology, inclusion of videos, movies, hands on activities and internet for better understanding is becoming a norm. But it is unfortunate that with this advancement and upgradation somewhere, the blackboard is being neglected and ignored as one of the very effective and important aids for teaching. We must understand that what the teacher writes on the board helps children build an emotional connect with the teacher. It is a kind of personalised or customised information. The work on the blackboard compared to a PPT can be seen as a handwritten card or letter compared to an e-greeting or a text message.

How well planned the board work is has a great impact on learning. Many a time, we forget that the content flashed on the smart board is something virtual for the children, but what the teacher writes and how she/he writes it helps students develop a link between the explanation and written content and kind of gives a 3-D effect to the concept.

I still remember how much I loved my grade 8 maths teacher for her neat and well organised board work. We never had to struggle to find details or to understand concepts because of the clear sequencing of the steps. Her beautiful handwriting inspired all of us to work neatly and that stayed with most of us. Whether geometry or trigonometry, as a class we learnt to work in steps and learnt to keep our note books perfectly neat.

Generally speaking, I have observed that even a very interesting activity (may be in a chemistry or physics class in middle school) or a beautifully done PPT (for Biology) does not end up as an effective learning experience (particularly on a long term basis), if it is not supported by proper blackboard work. It’s always good if the teacher can add her / his personal touch to any class with an intelligent, smart and appropriate use of the black-board.

With minimum cost and effort, the blackboard can be beautifully utilised for multiple purposes of content delivery, recap (of the previous or present class) and important points like formulas, spellings, important/key words, etc. simultaneously. This is the reason why even the most high-tech class-rooms are not without a board.

In addition to this, the blackboard is a dynamic tool which indirectly prepares children for being more organised and neat in their work and encourages them to put a better presentation of their daily work or their work during written assessments.

A teacher who uses the board in a correct manner stands as a role model and leads by example for her/his learners in terms of maintaining good handwriting (motor skill) and proper use of space and resources. This holds correct not only for young children in primary school but also for students at University level. I would again like to mention that those of my Professors who maintained/ utilised the board properly used to be our favourite teachers.

One more important aspect of using the blackboard is that it reduces dependence on electricity or power sources and reduces the screen time for the learners, which is again a concern due to increased use of mobile phones and computer, particularly with the younger generation.

A teacher's blackboard work engraves a personal mark on every learner's psyche and gives a very personal touch to whatever she/he would have taught. So while we embrace all the new and wonderful techniques to make learning a happier process, let us not give up on our older practices without weighing them up properly.

It is something like: when you make new friends you do not break your bonds with your older pals.

**Farheena** currently works at Christel House India, Bangalore, which is a special school run by an NGO, for underprivileged and economically weak children. She has a post-graduate degree in Physics, specializing in Astrophysics and Plasma Physics from University of Delhi and a Bachelor's degree in education from the same University. She takes pride in being a teacher and a learner for almost 15 years now. Across her journey as a teacher, handling children in their late adolescence (grades 10-12), she has learnt the virtues of patience and empathy. She may be contacted at farheena1530@gmail.com

# Preparing TLMs from Waste Material and Using Mathematics-Science Integrated Instructions in Classrooms

**Harish Nautiyal**

**Introduction**

In an elementary or a primary school, classes I to 5 are taught Hindi, Mathematics, Science, English and Sanskrit. In most schools only two teachers are available depending on the number of students. Moreover subjects like Mathematics and Science are taught by the same teacher. We can also put it this way that a teacher has to teach ten subjects in a day and this arrangement results in 1) completion of the curriculum without developing an understanding of the concepts and 2) developing an understanding but inability to complete the syllabus.

Both the situations are not good for the students, particularly in remote rural areas where students are the first generation learners. These areas lack basic facilities like electricity, communication, television etc. and the availability of school resources is also not enough. In a situation like this, it is essential to develop the understanding and logical capacity of the students and give them complete knowledge as per their class. In order to do this, it is necessary for a single teacher of mathematics and science to think and develop certain innovative methods by integrating mathematics and science where the concepts of these subjects complement each other in a way that helps save time and maximum number of classes develop an understanding of basic concepts.

In this context, this article talks about concept, efforts and partial results of a method where mathematics and science are taught in an integrated manner. It is being presented with the supposition that it can be effective in the process of teaching-learning at large.

**Objectives**

1. Creating integrated methods of teaching mathematics-science and to manage time, class and innovations to develop a common understanding for different classes.
2. Creating such TLMs in mathematics-science so that both the subjects can be nurtured and the abstraction in these subjects could be made tangible for the children.
3. Developing integrated thinking in learners so that they are able to imbibe the concepts of mathematics and science simultaneously.

**Plan of work**

1. Procuring materials such as wood, stones, and cardboards etc. as resources from surrounding environment.
2. Building various shapes with children.
3. Hands-on learning about the structures, similarities, differences and interconnections between the shapes.
4. Use of TLMs of mathematics in science.

**Process**

My school, Government Primary School Sankari, is located in a hilly and remote region in Mori block of Uttarkashi. At present construction work is in progress there, so we get a lot of waste material in schools such as pieces of wood, cardboards, mud, cement, pipes and wires etc. In the first phase, the students were given the opportunity to gather material for similar shapes in mathematics and science. These matching shapes were then sorted out and the remaining material was kept aside for making TLMs.

**Second stage**

At this stage, TLMs were made using the collected and other materials with the help of the children. While making them we kept in mind the understanding that these TLMs would bring. Efforts were made to develop an understanding of length, width, weight (light and heavy), geometrical structure, addition, subtraction and the state of matter etc. of materials collected by the children. They made triangles, squares and rectangles using cardboard and wooden pieces and made circles, squares etc. using mud and cement.

**Third stage**

The shapes that were created collectively to make

TLMs were segregated in this stage. Then they were refined using other resources such as tapes, colours, saw, sandpaper, paint etc. Discussions were held in class regarding their usage and arrangements were made to store them safely.

**Fourth stage**

The fourth stage of the process is quite a dynamic one. Certain concepts were selected in mathematics and science from the curriculum of elementary classes so that the children could understand both the subjects in an integrated way and develop a common understanding by using these TLMs.

For example, children were helped to develop an understanding of length and width while building shapes, they made circles from clay and cement to develop an understanding of weight (light and heavy); they observed state of matter and tried to understand the concepts of ascending and descending order.

**Children's reaction**

Since the children were involved in preparing TLMs, they showed a great interest in learning during the process of teaching-learning. They began to understand the general concepts of mathematics and science such as the form of the shapes, measurement and weight, big and small etc. while searching for and building the resources itself. Children were able to get a feel of different types of triangles, rectangles, dividers, scales etc. by touching them. Consequently, children began moving towards understanding the abstract ideas of these two subjects in a concrete way.

**Conclusion**

There are many issues pertaining to elementary education today: from lack of human resources to paucity of time and teaching materials. In spite of these inadequacies we have to keep one thing in mind and that is the future of our students which should not be made to stop at any cost. It is necessary in today's world that we make the effort to be a better facilitators and TLM makers, understand nature as the source of resources and consider ourselves as a biggest means to facilitate learning. Mathematics and science are complementary to each other and nurture each other. What is necessary is integrating of these subjects based on the level of the class by keeping the concepts and ideas in mind, and displaying it in a concrete form and a simple manner.

Together with the children, I made an attempt to prepare TLMs with waste material available around us and to refine them creatively. In this process, the effort was made to see how science or EVS and mathematics could be taught together using those TLMs. With the help of this type of integrated teaching-learning we will be able to teach different classes together and will be able to establish the concept of previous knowledge, present knowledge and a thought for the future in a multigrade situation. This process will definitely save time in teaching and we will be able to utilise this time and effort in shaping a few new dreams, developing understanding and finding new integrated ways of teaching-learning methods.

*This article was originally written in Hindi. It was translated to English by Nalini Ravel.*

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# BINGO – A Versatile Game for Playful Learning

Indira Vijaysimha

Play and games appear to be in opposition to the serious work of teaching and learning within classrooms. They are associated with fun, happiness, joy and laughter all of which seem to have limited or no place within classrooms. Yet, play is deeply connected with learning. According to Dr. Stuart Brown, a pioneer in research on play, humour, games and fantasy are more than just fun. Plenty of play in childhood makes for happy, smart adults -- and keeping it up can make us smarter at any age.

The term *playful learning* was used formally in research by Resnick (1999) and the idea has been developed further since then. Learning can be supported by free play or guided play. Children everywhere, when left to themselves, naturally engage in free play. They explore their surroundings based on their own curiosity and in the company of peers. Such explorations help children discover who they are, what they like or dislike and how the world works. Free play also has the potential to develop both children's cognitive skills and their social skills (Fisher et al., 2010). However, when we have specific learning goals we cannot leave things to chance in the hope that children will naturally encounter appropriate experiences and information during free play.

Guided play is intermediate between free play and direct instruction where teachers structure the play environment to support the learning goal. For example, if the goal is to help children understand numbers, then they can be provided with blocks or beads in various colours and the teacher could go around asking children to say how many beads of a certain colour are there and so on. During guided play if the teacher takes too much control then "it becomes co-opted play, or in some cases the more didactic pedagogical approach of 'direct instruction'." (Hassinger-Das et al, 2016) In my experience, teachers easily slip into the control mode during guided play and this becomes counter-productive. In order to support learning, both free play and guided play should provide space for children's agency and autonomy. Adult involvement should be limited to minimal scaffolding. Vygotsky (1933/1978) has shown how pretend play allows children to develop self-regulation and flexibility since children voluntarily abide by self-imposed constraints during such play.

Play involves fun and voluntary involvement of children and learning is fostered because children are active, engaged and socially-interactive and focusing on material that capitalises on their interests and is meaningful to them (Chi, 2009; Hirsh-Pasek et al., 2015, quoted in Hassinger-Das et al., 2016). Play is child-led and when adults take control over the 'fun' activities, they become like chocolate-coated medicine that children are forced to take. In such a situation, the bright eyes of children lose their sparkle and they either become passive or rebellious and neither play nor learning happens effectively.

Hassinger-Das et al (2016) have argued that games involve fun and a sense of curiosity in active, engaging, meaningful and socially interactive contexts and that they belong alongside free play and guided play to form a trio of playful learning experiences. We all have childhood memories of playing games like hide and seek, *lagori* or *langdi-tang* as children. Unlike other forms of play, games involve players in competing according to rules for the purposes of achieving a predetermined outcome within the game's system. Even if the outcome of a game is the same each time, the route to achieve the outcome may change.

Games may be based on choice or chance or a combination of both. Tic-tac-toe, for example, involves only choice and not chance; on the other hand, snakes-and-ladders involves only chance and no choice. More advanced games involve both choice and chance. While playing games, children experience intrinsic motivation and interactivity. If the game has an appropriate balance between difficulty and children's skill levels it presents a challenge that is similar to scaffolding by teachers or other adults. Overall, games feature play elements like fun and a sense of curiosity to keep children engaged.

The way in which games incorporate rules and procedures is compatible with playful learning. During games children's action and chance impact the outcomes and when adults play with children they can provide some scaffolding to help children understand the rules of the game. Unlike in the case of direct instruction, the child retains control and agency during game playing. 'For example, in board games, there is often excitement associated with spinning the spinner because of the unpredictability of the situation. In this context, the adult has as little control as the child.' (Hassinger-Das et al., 2016, p 197. Games that specifically incorporate academic content or skill- building would obviously provide opportunities for playful learning. Researchers focusing on digital games have already created a term for games designed for learning – 'serious games'.

With the goal of making learning more playful let me introduce a game that is simple but versatile in the way it can be adapted for different content – Bingo. Some of you may be familiar with the party version of this game called *Housie* or *Tambola*. One person calls out random numbers while participants have record sheets in front of them with a selection of fifteen numbers. The person to win a game is the first person to have all of their numbers called. They call out *Bingo* and win the game. Three different adaptations of the game for use in the classroom are presented below:

1. **Picture Bingo:** This can be used with young children learning a new language. Decide on a list of 25 words for objects/animals/fruits/birds that you want children to be familiar with. Write each name on an index card. This step is not required if flashcards are already available. For each child prepare a sheet with 3 X 3 grid of 9 squares. Each square should have a picture of any one object from the list. The order of the pictures in each sheet should be different. In order to play the game give each child a sheet and some stones or seeds that can be placed on the picture. Instruct the children to place a stone on the picture if the matching word is called out Shuffle the 20 cards and call out the words one by one. The first child to have stones on all the pictures calls out *Bingo*. You may continue reading out all the cards and thus allow all children to complete. Alternately, you may take back the sheets and shuffle them before distributing them to the children again. Shuffle the set of 25 cards and begin the game again. Two or three children can cooperatively work with a single sheet if the class is large and you don't have time to prepare sheets for each child.
2. **Shapes and solids Bingo:** Write 20 (or more) clues/definitions for different shapes and solid figures on index cards. For example: **Square** - A figure with four equal sides and four right angles; **Sphere**: A solid shaped like a ball etc. Prepare 3X3 grids on hand-out sheets and ask children to fill one name from the list of shapes and solids in each space on the grid. Read out the clues one by one from the index cards and ask students to tick the matching shape on their hand-outs. The process of reading out the definitions, and the students trying to find matches continues until one student correctly ticks all nine words. Check the winner by rereading the definitions/clues used. This step not only keeps everyone honest but also serves as reinforcement and provides an opportunity for students to ask questions.
3. **Periodic Table Bingo:** For this you will need 4X5 grids with names or symbols of elements printed in each square. Each grid should have a different order of elements. Decide beforehand what is the winning combination – for example all elements in the middle row, or all four elements in the corners. You may choose to give your students a periodic table as reference. Each student should also have coloured pieces of paper or plastic discs. Begin by reading clues about the element and allow students about five to ten seconds to mark the appropriate element on their card. Students should listen to the clue, determine if that element is on the card and place a coin, piece of paper, or disc on the indicated symbol. The winner should shout Bingo when he/she has marked the correct pattern of elements on the Bingo card. For younger students you may choose to call out the atomic number of the element and allow the students to reference the periodic table. The more often you play this game the more familiar your students will become with the periodic table of elements.

I hope that many of you will try out some variation of Bingo in your classrooms and get creative with your adaptations. You will discover like I did, how popular this game is. The internet has plenty of resources for variations on the game and I even found one that had been used for a sociology class (Coco, A, et al., 2001) In my work with teachers I have often taught some version of the game and many a time teachers have reported back with delight about using it in their classrooms! That is an indication that games and fun can and be part of serious teaching. Research also supports the idea that playful learning is often effective.

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# Teaching-Learning Materials: Challenges of Using Them

**Javed Akhtar**

Teachers use various teaching-learning materials (TLMs) during teaching. For example they use the globe while explaining the earth; potatoes, knives and protractors are used while drawing latitude and longitude lines, teaching of counting is done with the help of pebbles, mobile phones are used to show a video of Tundra region etc. Here globes, potatoes, knives, protractor, mobile phones and pebbles are being used to clarify the topic. These materials are helpful in the process of teaching and learning. For example, when the children are told about the earth being round and a globe is shown to them in order to bring clarity to this concept, then the globe is helping the teacher in explaining that concept and the child is helped in understanding the same. So the materials used during classroom transactions in order to facilitate teaching-learning process are called teaching-learning materials or TLMs.  It depends on the teacher and the topic. It also depends on the teacher whether s/he uses teaching-learning material in the class or not. If the teacher does not use teaching-learning material in the classroom at all then obviously s/he does not face any challenge.

In view of the importance of the teaching profession, the professional educational qualification (B.Ed. or D.Ed.) has been made mandatory to become a teacher. Students are required to complete several teaching exercises during the training, which is done in a nearby school. Practice teaching is a very important part of training since it is here that the students understand the use and importance of teaching-learning materials. But in most of the training colleges, the practice teaching just a ritual and formality. Which means that either practice teaching does not exist in the college or even if it does then it is done without any teaching-learning material and plan.

I had gone to Raipur on one of my scheduled school visits.. I met the students from a nearby training college there who had come to work as teachers to gain experience. I went to their class and found that no teaching-learning material was used, no teaching plan was there and not even a single professor from their training college was present. This is the case with most of the training colleges. They do not take practice teaching seriously and even if they do, the students use TLMs only to get better marks/grades. This being the case, such TLMs are prepared by professionals who charge huge amount of money. Because of this the materials are so expensive that it is difficult to bring them to class.

Although training has been made mandatory to become a teacher but most of the teachers who are teaching in the state-run schools are appointed as contract teachers under *Sarva Shiksha Abhiyan* and there is no mandatory training required at the time of appointment. Many of them even completed their college education later. Their honorarium, at the time of the appointment, was one thousand rupees and people did not want to engage in this. But according to the rules of Right to Education Act 2005, no teacher could be appointed if s/he was untrained and so they were trained and the purpose of this training was not to learn but to fulfil the eligibility criteria in order to remain in the job. Secondly, this training was done through distance education. Obviously there is a qualitative difference in a regular training programme and a distance education training programme, especially when one is also working in a school. It was disadvantageous for such working teachers. They did receive the training and earned the eligibility but their ability remained unchanged.

Learning is a lifetime process. So the provision for in-service training was made to build the proficiency of the teachers continuously and on a regular basis. In-service training programmes continued under *Sarva Shiksha Abhiyan*, but today the situation is such that no teacher wants to attend them. Even today training is happening and along with the government sector a few non-governmental organisations have also entered the arena. Either the readymade TLMs are being given or they are being made in these training programmes or teachers are motivated to make the materials themselves. The main problem of the teachers is how to use such materials which is not addressed in the training programmes and if there is slight difficulty in using them then the teachers stop using them. Also teachers do not use teaching-learning materials in order to preserve them for a long period of time. They fear that if they get spoilt or destroyed then how will they get them back again or if the authorities want to see them what will they show them. As a result of this all the teaching-learning materials of the school remain in the cupboards under lock and key.

Under *Sarva Shiksha Abhiyan*, the schools were opened within 01 kilometre of every habitation. The schools were started with twenty or more children but only one or two teachers were appointed. Now there are five classes but the number of teachers is two or three only. This situation demands that the teacher remains in the classroom continuously. Most of the time is spent in engaging and handling the children and hence teaching takes a back seat. How can one even think of using teaching-learning materials in a situation like this?

During my school visit in Raipur (Chhattisgarh), I found that many teachers do use the teaching-learning material in the classroom despite all the challenges. For example, showing the video of Tundra region with the help of a mobile phone, counting with pebbles, showing the video for explaining the changing seasons on the LEDs, keeping gram seed in wet cotton wool to show germination of seed, using cards to explain different types of fractions, observing cells with the help of a microscope etc. One could see their determination in using these teaching-learning materials because all they wanted was to provide a better learning opportunity to the children in their school. So despite challenges in using teaching-learning materials, some teachers have found opportunities to use them so as to shift their teaching from rote learning to understanding. And this is happening not because of any fear or administrative action, but because of the strong willpower of the teachers.

*This article was originally written in Hindi. It was translated to English by Nalini Ravel.*

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# Exploring Science through Commonly Available Materials

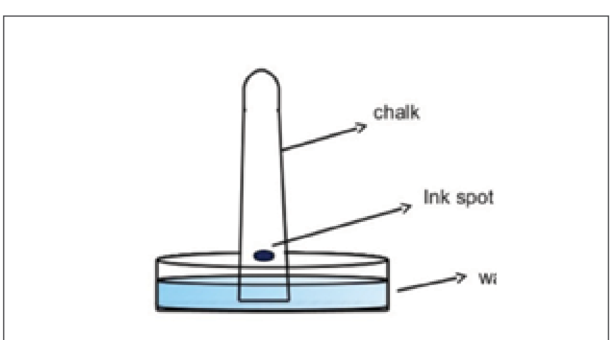
H R Madhusudan

*"If science is poorly taught and badly learnt, it is little more than burdening the mind with dead information and it could degenerate even into a new superstition"*

*D S Kothari Commission Report*

The quote above was a favourite one of one of my teachers, Dr. T K Jayalakshmi, who taught us Educational Psychology and Methods of Teaching Mathematics at R V Teachers' College. Somehow, the impact of this quote on me persists even to this day. But what I have not been able to understand are the meanings of *'poorly taught' and 'badly learnt'*! I suppose, as classroom teachers we have a sense of what they mean. A good teaching-learning practice involves conducting interesting activities that bring scientific phenomena into the classroom and enable children to SEE science in action. One does not need sophistication of a formal laboratory for this. Commonly available materials, a mindset to think 'out-of-the-box' and a curiosity to adapt those materials to demonstrate scientific concepts are all that are needed. We have mentioned a few examples of this approach.

**Chalk:** We know that chalk is a porous object. It is often used as an ink-blotter. The same property can be used to demonstrate **chromatography**, a fundamental principle of separation of mixtures –, an important method to separate components of a certain type of mixture.




Add a drop of black sketch pen ink along a thin groove made parallel to the base of the chalk. Stand the chalk in a plate containing a small amount of water. Make sure that the level of water is below the groove. After a few minutes, different colours appear at different heights from the groove! Black ink is composed of a mixture of different pigments. The mixture in a solvent gives the perception of black! In fact, there is no single pigment that give out 'black colour' (Why?). This is a big, counterintuitive idea.

Let us continue with the chromatograph experiment. An experiment or a demonstration without questions or discussion of the observed result or phenomena is totally useless, misplaced and a great distractor to learning. So, here are a few sample questions related to this experiment: why do pigments separate out at all? And why at different heights? What is the force that 'carries' the pigments against gravity? Do black inks manufactured by different brands have same colours mixed in them? Are inks of different colours also formed by a mixture of pigment of different colours? Is a dustless chalk better that the ordinary chalk for this experiment?

**Mahogany Pod:** Mahogany is a common tree, especially in Bengaluru. While it is a popular choice in furniture-making, its pod can be a teachers' delight. What can be taught using it? Well, it can be a TLM for many a concept across various subjects and topics.

Mahogany pods are found packed in a shell. As summer approaches, the shell cover loses water content, dries up and develops cracks on its surface. And at some point the shell breaks open showering down the pods packed inside. The shower itself is a treat to watch. Each shell has more than thirty pods. The first question that one can ask (it is fine even if the answer is not immediately forthcoming) is the packing fraction of each shell – what percent of the volume of the shell is occupied by the pods. It will be an interesting and open-ended exercise for children to answer this question. Next, is the packing fraction nearly the same in all shells? Can we 'suggest' a better way to pack more pods within the same volume without altering the pods' behaviour? The behaviour is this: as the pods fall freely, they begin to rotate after falling a certain distance! Why do they rotate? Is the direction of rotation of a single pod always the same – one can drop a pod repeatedly to answer this question. Do all the pods in a given shell demonstrate the same sense of rotation? If not, if the direction of rotation – clockwise and anti-clockwise – equally distributed over a large number of pods? If the direction of rotation is biased, why is it so? What has the structure of the pod to do with this unusual rotational behaviour? How is the rotational behaviour affected if we progressively chopped the pod – a small portion at a time?

Suppose we time the fall of a hundred different pods from the same height – would they all have the same 'Time of flight' that is, they stay in air for the same duration? Is the time of flight affected by the mass of the pod? Can we establish an empirical relation between mass and 'time of flight'? If the 'time of flight' differs, what are the factors that affect it? Among these factors, which are the dominant ones? All the questions listed so far are the kind of questions a teacher of physics / mathematics would be interested in. However, a biology teacher may want to ask 'Why did the mahogany pod evolve this behaviour? What is the survival advantage of such a behaviour? And, why should the Mahogany tree invest so heavily by way of producing large number of pods? After all, pod production consumes enormous amount of energy. Actually, mahogany pods are dispersed by wind. Suddenly we 'see' the tree's rationale behind this behaviour. For a survival advantage, the 'time of flight' has to be maximised. This is where rotation is important. Much of the gravitational potential energy translates into kinetic energy of rotation leaving behind a smaller 'kinetic energy for translation'! This will ensure that all the pods don't fall in a heap and compete with one another for the same, limited resources for their growth and development. This is nature's way of keeping away sibling rivalry' among the pods! Actually there are different species of mahogany in which the pods are designed differently with the function being the same!

Now, one can revisit all the questions raised above and compare the results across different species. A teacher needs to put a little effort in collecting these varieties during January to March or so. It is very easy to collect several hundreds of these pods. It is highly instructional to challenge children to simulate the behaviour of falling Mahogany pods using paper models. Now, they have complete control over the shape and size and mass of the paper 'pod'.

In this one set of activities, we can take a child through the methods of science and scientists – to observe, to measure, to gather data, plot graphs to establish relations among various parameters, to have hypotheses, test the hypotheses through models…. Several more can be added to this suggested partial list of questions appropriate for primary through to high school. One can use the falling pod to teach conservation of energy. At a slightly higher level, or for highly motivated and ambitious children, higher order questions can be raised such as: what makes the pod rotate? Rotation requires torque and how does it arise in this case? How does the speed of the falling pod vary with distance covered? Observe the similarities and differences in the variation of speed of the pod when dropped from different heights. Is this a case of accelerated motion? What are the forces acting on the pod?

So we see that a mahogany pod falling under gravity is potentially a 'material' that provides rich learning experience covering several concepts in mechanics. One can ask different questions appropriate to the concept being discussed in the class or the study itself can be a project-oriented learning after all the relevant concepts have been discussed.

Are there pods designed differently that rotate as they fall?

*Nature is an imaginative designer - different designs with one function*

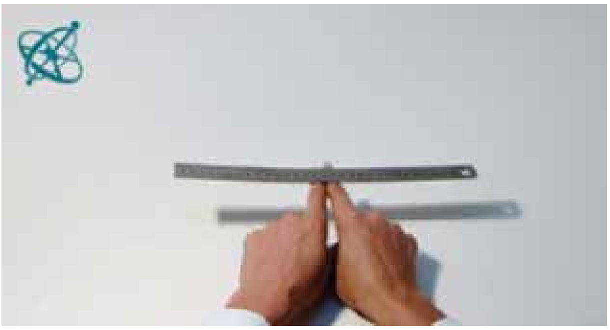
Well, evolution has brought about several designs for the same behaviour and function. It will be interesting for children to explore those as well.

My next prop that is commonly available and which can be used a TLM is a metre ruler – yes, a ruler or a scale! A teacher in a classroom normally uses a ruler either to draw lines in a geometry class or as an instrument of threat to maintain 'order' in an unruly class. The effect of a ruler, however, transcends these traditional uses. Several concepts can be demonstrated with a ruler. We will discuss just a few of those and leave the rest to the creativity of teachers.

1. Press the ruler down firmly on a table surface as shown in the photograph. Gently pull the 'free end' of the scale down and release.

   The free end of the scale now oscillates. Now, children can ask and explore several questions such as: Is the ratio of number of oscillations to the time taken to execute that, a constant? Does the ratio depend upon how much the free end is pulled down before releasing? How does the ratio change the fixed edge of the scale is scale at 5 cm mark, 15 cm mark, 25 cm mark and so on? Repeat the above experiments by placing a small weight, say a lump of plasticine clay at the free end. How does the ratio compare now? How does the ratio change if the lump of clay is stuck at different distances from the free end?

2. Support the two ends of the metre scale on stretched forefingers, as shown in the figure. Try moving the two fingers simultaneously and towards each other – towards the middle of the scale. Children will find that it is impossible to



   move (slide) the two fingers at the same time! Only one of the fingers moves for some distance before it stops and the other finger begins to move now. Now to the questions: Why can one not move both fingers simultaneously all the time? Why use fingers alternately? What pattern do we notice in the switching distances? Where do the fingers finally meet? Where would the fingers meet if a small lump of clay is placed on the scale at 10 cm mark? 20 cm mark? What is the role of friction in this experiment? What would the experimental results be if the fingers were oily? What if fingers are replaced by pencils?

The experiment mentioned above teaches several interesting ideas related to static and kinetic friction, centre of mass and torque

A rubber balloon is another useful material. One of the experiments that textbooks often describe to demonstrate that air has weight is shown here.

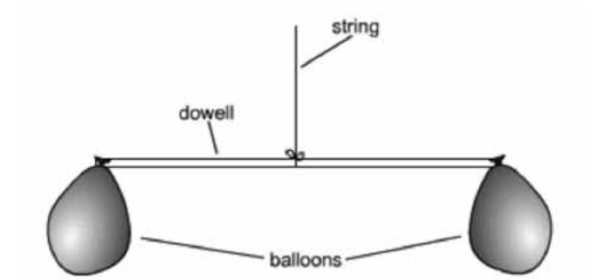


Diagram 1

The stick is shown to be balanced when both balloons are deflated or when equally inflated. The end of the weighing scale that carries balloon that is inflated more tilts down. This experiment supposedly demonstrates that air has weight. The teacher can now ask the children to repeat the experiment with water in place of air – water-filled balloon submerged in a tank of water. Would the water-filled balloon tilt the weighing scale at its end? In other words, does this experiment demonstrate that 'water has weight'? Experiments cannot be wrong. Our interpretations of the observed behaviour can be wrong! We have deliberately not answered the question raised above. This activity also shows how science is, sometimes, taught 'badly' and learnt 'poorly'.

These days powerful neodymium and ceramic magnets are easily available and are not expensive. Treat them NOT as magnets alone but as agencies of force. This orientation opens up avenues to use them to demonstrate and teach a number of concepts in mechanics. We will list, as usual, a couple of those.

1. Take a lightweight toy cart. Stick one of the magnets on top of the toy using cellophane tape. Bring another magnet near the magnet on the toy. The toy accelerates- force brings about acceleration. Next, stick the second magnet a couple of millimetres away from the first, using cellophane tape. Does the cart move now? This is perhaps the most instructional demo on Newton's third law of motion. Students' free body diagrams of the set up sometimes show the action-reaction pair acting on the same body! This demo clearly shows the result of action and reaction acting on the same object.

2. What does a weighing machine measure? Some relevant discussion by the teacher in the classroom is a must, in order to appreciate this question followed by the activity suggested here. Ceramic magnets that have a hole in the middle ('doughnut shaped' as they are called) are slipped through a stick as shown in the photograph. Check the reading on the weighing scale. Would the weighing scale register the same weight if the magnets are in repulsive mode? Perform the experiment after the children have answered this question. The teacher has to moderate a discussion before and after the second part of the experiment. This activity actually tells them what exactly a weighing machine measures!

*What would the weighing machine register in each of these cases with same magnets?*

Profound ideas such as these can be discussed and demonstrated using commonly available materials. As classroom teachers we must develop a habit of learning the properties and uses of things that we use. That will help in developing activities / experiments using those materials. Plastic bottles and pipes, PVC pipes, syringes, toys, packaging materials like thermocol and bubble wraps, aluminium foil used for food packaging and so on. One has to prepare a list of such materials along with their properties. Of course, looking at the primary application we can infer at least a couple of properties such as thermal conductivity, density, transparency. It takes time for one to shape one's thinking along these lines. It is worth the time spent, though. More importantly, we would not be letting science degenerate into 'new superstition'!

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# Authentic Material and the Communicative Approach to Language Teaching

**Nivedita V Bedadur**

Let us think of a child learning her mother tongue. She is surrounded by people who speak to her and are happy even if she speaks a few broken words. Everybody applauds and celebrates her mistakes. The world of the child is rich with language! Can we build bridges from the child's world to the classroom? Can we apply the principles of natural language learning to language teaching in the classroom? Can we use what the child sees and does in her early years, in her culturally rich environment?

Communicative Language Teaching was born out a desire to bring about a change in the traditional approaches to Language Teaching. It aims at bringing language learning closer to the life, the identity and culture of the child. The following chart captures the key principles of difference between traditional and communicative approach to language teaching.

| Traditional Approach | Examples | Communicative Approach | Examples |
|---|---|---|---|
| The focus is on grammar | | The focus is communication | |
| Grammar is taught through learning rules and practicing sentences | Learning about countable and uncountable nouns. Filling in the blanks. | Grammar is acquired by communicating in groups in the classroom The communication uses cultural materials and tools. | You are going to have the pre-wedding ceremony of your cousin's wedding at your house. Your parents and you will be cooking. Talk to your grandparents and parents and make a list of things you need |
| The focus is on learning the skills: listening, speaking, reading and writing. | Listening Tasks with fill in the blanks.<br>Speaking Tasks of repeating dialogues | The focus is on doing tasks which integrate the four skills and create opportunities for thinking.<br>The focus is on tasks that happen in social settings. | A task which involves watching TV news about a road accident, talking about your experiences, collecting information about the causes of accidents through a survey which you conduct on family and friends.<br>Then writing a letter to the editor about the cause of accidents. |
| The focus is on accuracy | Mistakes in pronunciation, spelling and grammar are penalised. | The focus is on fluency In our cultural and social settings children are encouraged to participate and the focus is never on the mistakes they make | Mistakes are considered as a part of the learning process. Games and play which are cultural artefacts allow children to use language without fear.<br>Observe the signboards of shops around you. What do they contain? Play name-place-thing to describe the things they contain. |

**Key Components of a Communicative Approach Classroom**

A typical classroom under the communicative approach is one where students are engaged in talking to each other in groups or pairs, while the teacher moves around from group to group helping the students. In short it is a learner-centred classroom. The teacher is a facilitator and a learner. She plans the communicative tasks for the students with the objective of providing them a rich language environment closely mirroring their lives and cultures at home. The atmosphere of the classroom is friendly, and non-threatening because the students are not afraid of being punished for making mistakes. Moreover they are talking to their peers in the first round and then, after gaining confidence presenting their group work to the whole class. This leads to a safe environment for children to practice their language.

**The Teacher's Role in a Communicative Language Teaching Classroom**

The teacher's role in a communicative classroom is very important. Based on the objectives of the lesson, she plans the activities that students can do in the classroom. These are based on the following principles:

a. Students need plenty of opportunities to talk about the theme or the topic. Pictures, visits to places, small stories, pamphlets or advertisements can be triggers to help children begin talking about a topic. Role play also helps to reduce fear and hesitation.

b. Students need opportunities to read and think, discuss and make notes before presenting ideas. Reading needs to be focused so questions, small comments or pictures help children understand the purpose of a text. This further helps them to think and respond to the requirements of the task.

c. The activities mirror the children's homes and social life, their culture in order to bridge the distance between the world of the child's home and the world of the classroom.

d. Writing can be taught as a process not as a product.

e. Grammar can be taught through a combination of the inductive and deductive approach by helping children to give examples and then deduce rules.

Let us now see how a teacher's plans her teaching and the resources she uses:

*A teacher divides the children into groups, then she gives them this task. What is she trying to revise or teach?*

Let us see below.

**i. Talk Group Work on a shared experiences**

The teacher divides the students into group and gives them the task. She ask them to talk with each other, share their experience of losing things. They also discuss how they recovered them. Then they do the task which is given below:

Your group was playing in the playground. While playing one of you has lost his favourite ball, pen, wallet, toy, game or any other thing. You have to describe it to the person in charge of the lost and found department. Mention the colour, size, shape, what is it made of, use, day and date of buying, whether scratched or damaged etc.

**ii. Role play based on group work**

The teacher divides the students into groups and gives them the following task.

One person from each group will play the role of the student who lost something. In the first presentation the teacher acts as the in charge of the lost and found department. The teacher asks pointed questions about colour, size etc. to the student to help the student describe vividly. From the second presentation onwards a volunteer from the students plays the part of the in charge.

**iii. Brainstorming and writing**

The teacher writes the words collected from the two discussions above on the board. She discusses different sentence starters for a notice. She distributes a sample notice from the school notice board. She discusses the layout of a Notice. She then asks the students to write a Lost and Found Notice describing the lost item and help each group.

**iv. Building bridges from the known to the unknown through pictures**

Next the teacher selects words from the list which are used both as adjectives and verbs: torn, scratched, broken, injured etc. and helps children to draw a picture of an accident from the newspaper. She then introduces them to the use of past participles as adjectives and nouns.

*Think: Why has the teacher asked them to talk, discuss, think more and more about a description and then write a notice?*

**Materials and Resources commonly used for Communicative Language Teaching**

- Pictures are used for finding the differences, describing things, sequencing a story etc.
- Role play cards help children to produce the language as they give hints and clues.
- Authentic materials like posters, wrappers, labels, advertisements help children to connect with things they already know

| Advertisement |
|---|
| Line 1: Emotional Appeal<br>Line 2: Description which is colourful (exaggerated?)<br>Line 3: Some facts |
| 90% Emotional Appeal 10 % facts |

| Advertisement |
|---|
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*Using newspaper reports and advertisements*

It all began with reading a small extract of a news item on the condition of student hostels run by the government to teachers of Class VII. The teachers reread the piece which was accompanied by a very touching picture of a student in a hostel. Then they wrote a report about the condition of student hostels. The teachers then did a role play: a press conference figuring the health commissioner and the hostel manager and a grieved parent. They reexamined their reports and shared, added and subtracted, editing and reediting their report.

The next step was to provide them with an advertisement of the child rights organisation, CRY asking for donations. We compared how the report and the advertisement were different in their structure. What is the proportion of fact and opinion in the two?

Teachers analysed the advertisement and the newspaper report side by side. The slow revealing of the structure of the two led to a deeper understanding. The activity ended with watching a very touching advertisement. After this the writing of reports and advertisements was easy!

In their reflection and feedback sheets participants reflected on why they now believed that authentic materials should be used in the classroom and how communicative tasks help the teaching of writing. They also outlined a framework for their use in the classroom.

**Using newspaper pictures in the classroom for process writing**

In the same capacity building workshop on Communicative Language Teaching and the use of authentic materials, participants were given random pictures from newspapers which showed people and things. The number of pictures were three times the number of participants. The pictures were then mixed and separated into bunches of three. The three pictures given to each participant were as dissimilar as possible. The participants had to create a story using the three pictures and share it with the entire group. After the presentation there was a discussion on the elements/ structure of a story. Many of the stories written by the participants were not stories in the real sense because the element of conflict and character were missing. Some stories were copies of films which had 'too facile' resolutions, too easy a change of heart. There was a discussion around the structure and elements of a story. The language of a story was discussed. The participants then wrote their stories again with a lot of sharing and discussion as they worked.

**Reflections of the participants**

The participants felt that authentic materials must be used for teaching writing because they connect with the real world. Use of authentic materials enriches children's vocabularies, and enhances creative writing and analytical thinking. They felt using authentic materials with the process approach created a complete experience which was both entertaining and educative. Both teacher and student would benefit, as students like interactive activities to help build higher order thinking skills. Children will have an 'aha' moment when they are able to interpret what they read outside and connect it to the classroom. It creates the continuum of authenticity by connecting the world of the classroom with the world of the home and street.

We culled the following principles for teaching writing as a process using authentic materials under the communicative approach which uses writing samples from the real world in different genres like: reports, advertisements, posters etc.

1. Language learning happens when there is an environment of the language around us, we are immersed in the environment of the language which is available in all the authentic materials around us. We need someone to help us notice, engage us in doing things with language and also to create opportunities for using the language.
2. Languages cannot be learnt by constant correction, mistakes are stepping stones to language learning.
3. We need to be given opportunities for using language while doing meaningful tasks in a continuum with multiple confidence building opportunities.

But what made my day was the letter reproduced below:

*Respected madam,*

*I was fortunate to attend the last session on, 'The effective use Of Authentic Materials in the Class room.' Today I taught the 7th Graders Report Writing with reference to a newspaper report. It was so effective that it did not take much time for a lengthy explanation. I read each and every line and asked them to distinguish facts and opinions. The structure of the report–introduction, content and solution part was also done in the same way as you did in the workshop. Ma'am the result is amazing. I am really grateful to you for introducing that activity. Like a student, I am eagerly awaiting the next session.*

*Warm regards*

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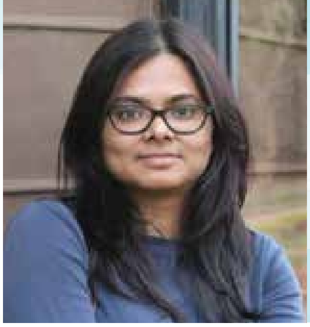
# My Business is to Create

**Priyadarshini Yadav**



William Blake has always been an inspiration to me. Imagination and creation have been the centre of human existence in his works. It was while briefly going through *Jerusalem: The Emanation of the Giant Albion*, few years ago, I came across the most touching lines of all that have inspired generations of artists and writers –

*"I must create a system, or be enslaved by another man's. I will not reason and compare: my business is to create."*

I always keep this sentiment at the core of my teaching and it must flow into my teaching practices. Teaching for me is like a form of art with all its glory and imperfections. There are ample opportunities to always go beyond the basic and do something extraordinary.

If I had to describe TLMs in layman terms I would say they are things we use in order to support our teaching and it helps us ease and strengthen the connection between the children and the topic being dealt with. As per my understanding, these can be a large number of things, but it was after reading *The Child's Language and the Teacher* by Krishna Kumar, that the real essence of a TLM became more evident to me. Everything – chit -chat in the classrooms, the scribbling/doodling they do everywhere, the little things that children carry (a piece of rock, a rubber band, some game cards, a piece of jewellery and even the little snake they have in their pockets), fights between children, the swear words they often use (Ashton-Warner, 1963), the songs they sing while playing – can be used as a TLM (Kumar, 1986). They mean something to children and it is these things that we mostly overlook when we think of TLMs. Most often or not, children are not allowed to carry 'rubbish' with them to school and if they do they are thrown away in garbage bins.

Throughout my classroom observations at a government school in a village in Chhattisgarh, it has been my understanding that the only TLMs used by the teachers during classroom transactions are textbooks, blackboard, chalk, duster and some picture charts that have seen better days. Loads and loads of children's books, given to the school by different organisations, have been locked away for ages in a trunk, as it was feared that children will tear them to pieces. I have often wondered why the TLMs provided to the school are never used while teaching but are locked away in a box. On asking, I was told that they do use them, which left me wondering as to how I never saw them being used in classroom.

My primary focus has been to utilise as many resources as I can that the children give me. I have tried to use the available TLMs and make modifications in them so that they fit in the classroom I work in. When I think of making a TLM, I try to keep in mind the conditions that are available to the teachers in the government school and the method and material should be within their reach.

### Modifying TLMs

While contemplating my strategy for English language teaching as a part of my classroom transaction, I have been looking for an approach that will successfully combine a variety of elements – building an English vocabulary and using the existing one, while introducing the letter sounds. So, when they start to identify words they can work further on identification of the phonic components. I had been working with the Jolly phonics (Phonics, 2018) in a Danish classroom. The videos made by them consist of little songs of two or three lines while introducing different words in English which help in the identification of the alphabet. Although the content in it (the choice of words and illustrations) is appropriate for children belonging to the European middle-class, there is no denying the idea of its applicability in a rural set up in India, with modification, of course. My primary concern was to build as many of those songs for every alphabet, with suitable illustrations. Another thing was that I wanted to present these little songs while using some words and sentences in Hindi so that they can help them connect with children.

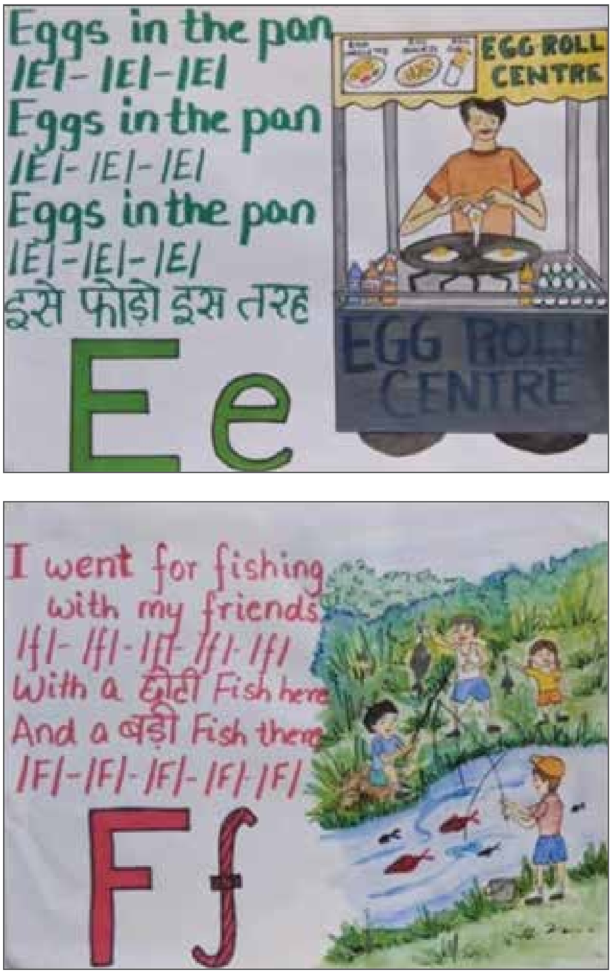



*Figure 1. The Eggs and fishing song illustrations*

While thinking about an illustration for the E song, I thought of using the concept of an egg-roll stall. This idea just struck me when I met two of the children from school, helping their father run the stall during their village *mela*. Most of the children I work with love to go fishing, so I decided to make a little fishing song for them (fig 1) with a few words in Hindi. Some of the children have goats as pets


*Figure 2. The 'Girl and the Goat' song*

and I have seen them play during the lunch break, and that is where the idea came for the *'Girl and the Goat'* song.

The things I am using to make songs are nothing but things from children's everyday lives. There are no limit to the ideas of a TLM and most of the ideas I use are given to me by children. Their language is a great TLM for a teacher. I try as much as possible to communicate with children in Chhattisgarhi – which, for me, is a modified version mixed with Bhojpuri, Hindi and whatever little Chhattisgarhi I have learnt so far.

Similarly, I have used the floors and walls of the classroom as a TLM on countless occasions. I used the floors to create a hopping game to help them understand the concept of multiplication tables and snakes and ladders for numbers and counting. I have never seen children enjoy themselves as much during a math class before.

*Figure 3. Children playing with the multiplication tables and snakes & ladders*

### Developing TLMs

Not only are books great forms of TLM, but the manner in which we narrate the stories and poems are an even greater teaching and learning aids. Children enjoy the expressions and silliness during the narration. It has helped me I have been working on is developing stories in English and Hindi that are based on the children I teach. I am working on 16 stories, one story for every child I work with. The illustrations are stills from real life which I have captured through my camera on different occasions. I have tried to hold on to the moments where children have been wildly engaged in something, for example – their expressions and reactions while reading a book (figs 4), the times I have been reading to them from a book and the times we were singing and playing outside just because the weather was pleasant, as seen in figure 5.

*Figure 4. Some moments I stole during the summer camp we organised in 4 schools of Bhakhara, Chhattisgarh*

*Figure 5. Some of my classroom activities*

### TLMs from recycled materials

I have been thinking hard about how I could make low cost TLMs using recycled materials. I had once given a jigsaw puzzle to the children of Class 3 and I could see how involved they were in putting all the pieces together. It gave an idea to make something simplified for children of Class 1 and 2. Therefore, this summer, I made a great collection of the popsicle sticks, keeping in mind the puzzles I wanted to make for language teaching (fig 6). I have saved all my cereal and biscuit boxes, toilet paper rolls and juice cartons which has led my colleagues and neighbours to believe that I might be a hoarder. But I have a larger goal in mind. I cut the printed alphabets on the cereal and biscuit boxes so that children can use them for building words activity. The juice box can be used for making a bus, a house and a funnel that can be used as a TLM for addition in early primary classes.

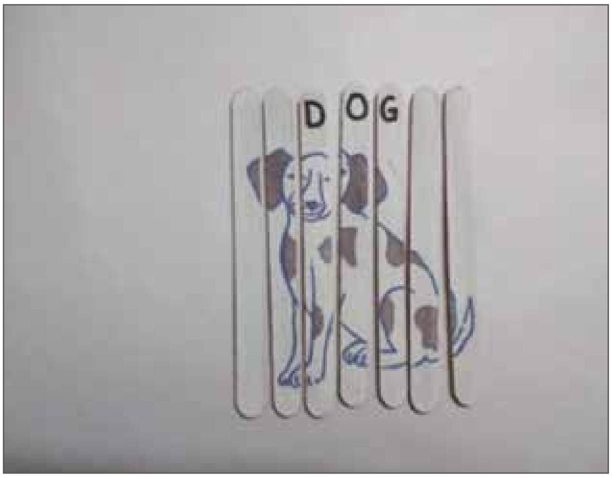




*Figure 6. Recycled ice-cream sticks TLMs*

It was only recently, during the In-Service Teachers Training (ISTT) in Kurud, Chhattisgarh, that a government school teacher mentioned that a teacher's behaviour and attitude with everyone and everything in school is also a great teaching and learning aid. The selection of words matters, because we are a part of their environment and, just like everything else in it, we are contributing towards their understanding of the world. Something I had never thought of separately as a teaching and learning aid. In the process of becoming a teacher, I've become so many other things – I've become an artist, a singer, a dancer, a poet, a patient and avid listener – to sum it all, I have become an interesting person. The contributions from each of the mentioned versions of me, is what I need to make a TLM.

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# On the Shoulders of the Technology Giant

**Sneha Titus**

Technology has become the persuasive buzzword in hard-selling educational institutions and educational packages. Yet how much thought has gone into the creation of a 'techno-classroom'? When does technology enable the class? How do we select tech-enabled teaching learning materials and teaching aids? Are they self-sufficient and if not, how do we supplement them in order to push the student's learning to the next level? How do teachers ensure that real learning has occurred in the tech-enabled classroom?

NCF 2005 speaks of the importance of inclusion. If teaching focuses more and more on the brilliance of technology to deliver good teaching, then spaces for discrimination will naturally arise along economic divides. If, however, the focus is on the pedagogical brilliance of the tech-enabled lesson, then even the simplest and most available technology can align with the vision of NCF. The clarities sought in teaching with technology should be illuminating rather than blinding. Though this article is about teaching aids which rely on technology, I aim to show that it is time to enable the teacher rather than the technology.

A teacher, who is a first time user of technology in the mathematics classroom, seeks to exploit the potential of the technology. But there is a danger of shifting the focus to the technology rather than letting the mathematics speak through the technology. Instead of seeing technology as an attention seeking device, I propose that technology is the giant on whose shoulders students can see further in mathematics. I will illustrate this with examples using GeoGebra which is an interactive geometry, algebra, and calculus application, intended for teachers and students. GeoGebra is written in Java and thus available for multiple platforms (including, now, the smartphone). Its creator, Markus Hohenwarter, started the project in 2001 together with the help of open-source developers and translators all over the world. Currently, the lead developer of GeoGebra is Michael Borcherds, a secondary maths teacher. Most parts of the GeoGebra programme are licensed under GPL and CC-BY-SA, making them free software. One of the sites from which it can be downloaded is http://www.geogebra.org/cms/. An excellent manual for new users of Geogebra is available for download at http://www.geogebra.org/book/intro-en.zip.

GeoGebra's user interface consists of a graphics view, an algebra view and a spreadsheet view. On the one hand you can operate the provided geometry tools with the mouse in order to create geometric constructions in the graphics view. Or you can directly enter algebraic input, commands, and functions into the input bar by using the keyboard. While the graphical representation of all objects is displayed in the graphics view, their algebraic numeric representation is shown in the algebra view. The user interface of GeoGebra is flexible and can be adapted to the needs of your students. If you want to use GeoGebra in early middle school, you might want to hide the algebra view, input bar, and coordinate axes and just work with the graphics view and geometry tools. Later on, you might want to introduce the coordinate system using a grid to facilitate working with integer coordinates. In high school, you might want to use algebraic input in order to guide your students through algebra into calculus. Though many sketches and activity sheets are available on the internet, GeoGebra works best when it is used as an investigative activity which is skilfully facilitated by the teacher. A GeoGebra sketch can be saved as a .ggb file and interactive worksheets with questions inserted at crucial points can even be created and saved at the user-friendly site https://ggbm.at/e9Z6UDu4

In this article, I propose to take a brief look at some ways in which technology is currently being used in the classroom, point out some of the inherent pitfalls therein and then suggest ways in which this can be overcome.

Why is technology used in the classroom? Some persuasive reasons are:

**Appeal:** Technology is often used to grab eyeballs and footfall measure is used as a criterion of success as often in the computer lab as it is in the shopping mall. Slick productions might appeal to those who are ambivalent about math but when they return to the classroom and the textbook, will this impression be reinforced? (Meyer, 2013)

**Availability and convenience:** Replacing the text-book with the screen and the integration of audio-visual teaching with the conventional teaching limits human errors but often this is the boundary to which technology is integrated into the lesson. (Graulich, 2009) Teachers find it very difficult to abandon the idea of the blackboard even if the blackboard itself has disappeared from the classroom. Very often a PowerPoint presentation is simply an animated version of the textbook and this passes as integration of technology into teaching. 'Functional fixedness' (the ideas we hold about an object) can inhibit our ability to use the object for a different function (Birch, 1945) can seriously limit the use of technology in the classroom.

Example 1:

Take a look at this GeoGebra activity Direct_common_tangent.ggb (Math Science Subject Teacher Forum, 2012). The construction steps for the GeoGebra sketch are given in the box.

| **No.** | **Name** | **Description** | **Tool** |
|---|---|---|---|
| 1 | Number d | | Slider from 0 to 20 |
| 2 | Number $R_1$ | | Slider from 0 to 10 |
| 3 | Number r | | Slider from 0 to 10 |
| 4 | Point O | | Anywhere on the graphics screen |
| 5 | Point A | Point on Circle(O, d) | Choose the option Circle with centre and radius and click on O as centre, when prompted for radius, key in d |
| 6 | Segment a | Segment OA | Choose the Segment option from the Line tool and click on O and A. |
| 7 | Circle c | Circle with center O and radius $R_1$ | Choose the Circle with centre and radius option |
| 8 | Circle e | Circle with center A and radius r | |
| 9 | Circle f | Circle with center O and radius $R_1 – r$ | |
| 10 | Point M | Midpoint of O and A | Choose the midpoint option from the Point tool |
| 11 | Circle g | Circle through A with center M | Choose the Circle with centre through point option |
| 12 | Point B | Intersection of f and g | Choose the Intersection option from the Point tool |
| 13 | Point C | Intersection of f and g | |
| 14 | Segment h | Segment B, A | |
| 15 | Segment i | Segment C, A | |
| 16 | Ray j | Ray through O, B | Choose the Ray option from the Line tool |
| 17 | Ray k | Ray through O, C | |
| 18 | Point P | Intersection of c and j | |
| 19 | Point R | Intersection of c and k | |
| 20 | Segment l | Segment O, P | |
| 21 | Segment m | Segment O, R | |
| 22 | Line n | Line through A perpendicular to h | Choose the Perpendicular Line option |
| 23 | Point Q | Intersection of e and n | |
| 24 | Segment p | Segment A, Q | |
| 25 | Line q | Line through A perpendicular to i | |
| 26 | Point S | Intersection of e and q | |
| 27 | Segment s | Segment A, S | |
| 28 | Segment t | Segment P, Q | This is one of the direct common tangents |
| 29 | Segment $a_1$ | Segment R, S | This is the other direct common tangent |

Created with GeoGebra

Using a series of animated steps, it merely gives the recipe for the construction of a direct common tangent. Though the sliders used seem to bring a dynamic dimension to the activity, it merely changes the size of the circles and in no way leads to the understanding of why this construction works or how it can be tweaked to devise similar constructions. What is detailed is the algorithm for the construction of a direct common tangent.

In what way will this promote mathematical thinking? On the other hand if this activity is planned by the teacher with an accompanying worksheet, it becomes interactive and lays the ground for the student to do the next construction (of the transverse common tangent) on her own. Here are some questions which can prompt inquiry on the part of the student.

1. Why was the radius of circle f the difference of the radii of circles c and e?
2. Why did circle f have to pass through O and A? (Hint: What is angle OBA?)
3. Why is the point of contact of the tangents determined by circle f?
4. When does this construction fail and why?
5. How would you construct transverse common tangents?

Example 2:

Consider the well-known theorem, 'The angle in a semi-circle is a right angle'.

In the classroom, students are often taught the proof using a figure which the teacher draws on the blackboard. However, when this theorem was given to students who knew how to use GeoGebra, interesting interpretations emerged.

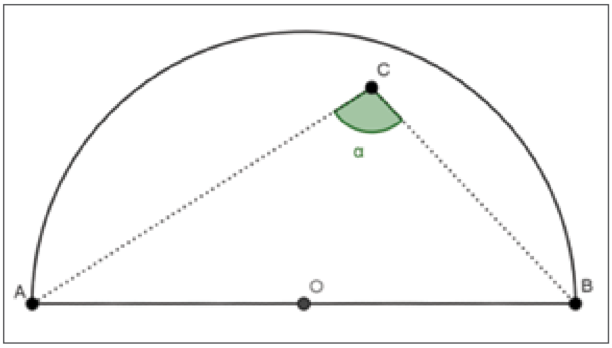


*Figure 1.*

These sketches are easily created using the Semi-circle option from the Circle tool. Angles can be

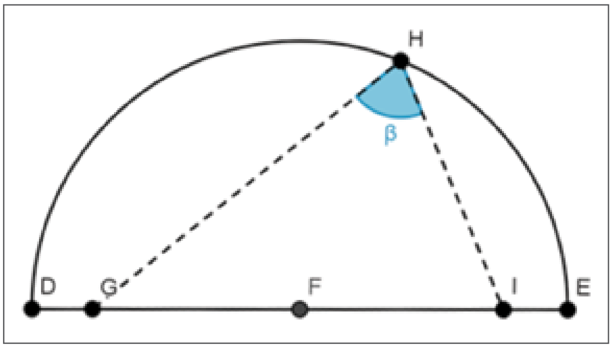


*Figure 2.*

measured using the Angle tool. But note how students interpreted the word 'in'. Though the angles look like right angles, the measure tool reveals that it is not. Student A immediately began to drag the point C and found that when it hits the circumference, the angle is indeed a right angle, wherever the point C is on the circumference. In the second case, the student tried moving the point H and found that the angle did not change significantly. He then tried moving G and found a significant increase as G moved towards D. This gave him a clue and leaving G at D, he proceeded to move I towards E. Immediately, he saw that whatever the position of H, angle DHE was a right angle. Allowing the student to interpret the theorem with a sketch surfaced their understanding. The dynamic nature of GeoGebra allowed them to understand the meaning of the theorem. Further, it helped them to understand the key mathematical concept of 'generalization'. Once they did this, the proof became ridiculously simple and obvious as they used the concept of isosceles triangles (which reinforced their understanding of the role played by the radii in the proof) and supplementary angles.

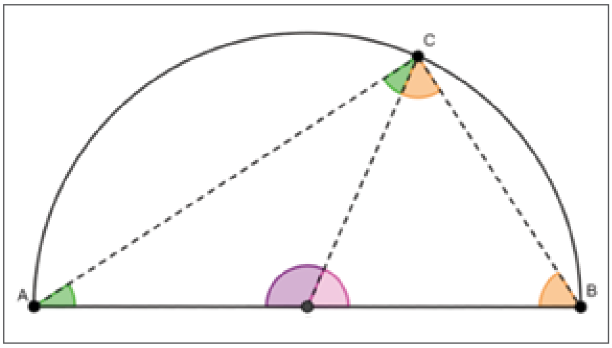


*Figure 3.*

Does the activity *challenge* them to *think* or to *guide* them to *accept*?

This is an important guideline for teachers to keep in mind while designing GeoGebra activities.

GeoGebra works brilliantly with paper folding activities and pushes students to understand the inherent geometrical relationships which facilitate such activities. For example, folding paper to get one point to fall on another can be replicated in GeoGebra by reflecting the point in the perpendicular bisector of the line joining the two points. When the crease is replaced by the perpendicular bisector, the laws of reflection come into play! Even intimidating topics like the locus of a point became child's play when we used paper folding to create conic sections and then replicated this on GeoGebra.

In conclusion, technology should be used in the math classroom for the following reasons:-

1. Students are digital natives and an intimidating subject such as mathematics now takes on a different complexion as the teacher is perceived as a fellow learner and not a giver of knowledge.
2. Technology enables students to experiment and move at their own pace and makes differentiated instruction easier to plan and administer.
3. Technology allows for dynamic investigation, leading to mathematically valuable strategies such as conjecture and proof.

Though the advantages of saving both time and effort is ostensibly used for teachers to plan the development of skills such as problem solving, team-work and collaboration, the focus is on how to use the software and very little effort is spent on training the teacher to work with it more meaningfully.

What should a school do to ensure good use of technology? Through this paper, I show that it is time to enable the teacher rather than the technology.

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# Stories and Doodles as Teaching Aids in Science

Sree Mahalakshimi

This article emphasises the importance of the art of storytelling in mainstream education even in subjects such as science teaching and outlines the method of creating story boards with doodles for classroom teaching.

Communicating is the key to every human life. Right from the moment we are born, we start communicating in various forms: we cry to let the world know that we have come alive into this world. This has led human beings to discover various forms of communication and storytelling is one among them. We get introduced to stories right as an infant from our mothers' bedtime stories and grandma's tales and we start narrating stories of our own from school, from our playing sessions, be it Ramu beating or Somu not sharing his cycle to play with. The stories have been etched in our lives.

Every story we have been told while growing up had a moral, or takeaway, and the best thing is that we still remember them. For example, we still recall the story of the Hare and the Tortoise, when we talk about slow and steady winning the race.

But all these happens in one's life maybe till the age of ten?! After that, which we get so caught up in studies that we totally forget to narrate and articulate. The art that we were born with just dies inside us: But why discontinue something that we have been doing since birth and when that something is so very powerful: why not incorporate it in the curriculum instead!

## Storytelling and cognition

Stories provide an opportunity to relate and organise important experiences in life. Though most of storybooks are associated with pictures, the words in the stories stimulate the production of pictures inside the brain of the child which develops thinking and imaginary skills in children. Putting together the imaginary story to make sense improves reasoning skills in children which are also the requirements for math and science.

## Inception of this Idea

In May, 2018 I attended an experiential science learning workshop recommended by one of my colleagues and it was one of the best places I have been to. We did lot of working models many science concepts: centrifuge, chromatography, diffusion were three among them. It was in this workshop that I met a storyteller who talked about weaving stories for explaining technical concepts like sun, solar system etc. for children. That is when the idea of teaching science with stories struck me and I went on the internet to find such story books. To my disbelief and disappointment, there were not many such storybooks or other resources that could be used in the academic context. That is when I decided to do my own storyboards with simple doodling for basic sciences.

## Creating your own story board - an introduction to doodling

Doodles are simple drawings or scribbles which can be made without much effort and at the same time have a concrete representational meaning. Though they are not a mainstream educational tool yet, I prefer them because one need not be an expert artist to doodle and the simplicity of resources needed to create them, namely, a pen and some paper which makes doodles a perfect academic tool.

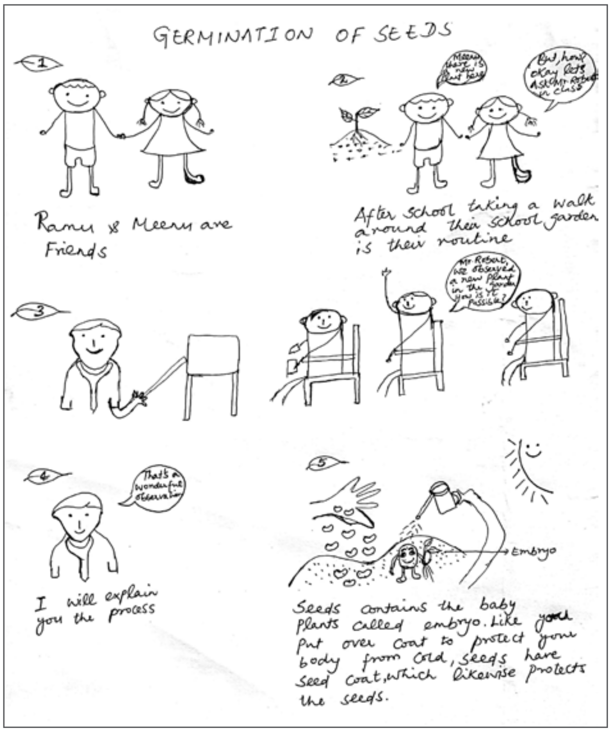
**Materials required:** A piece of chart paper or white sheet, a pen, topic on which you want to create the story and a story idea.

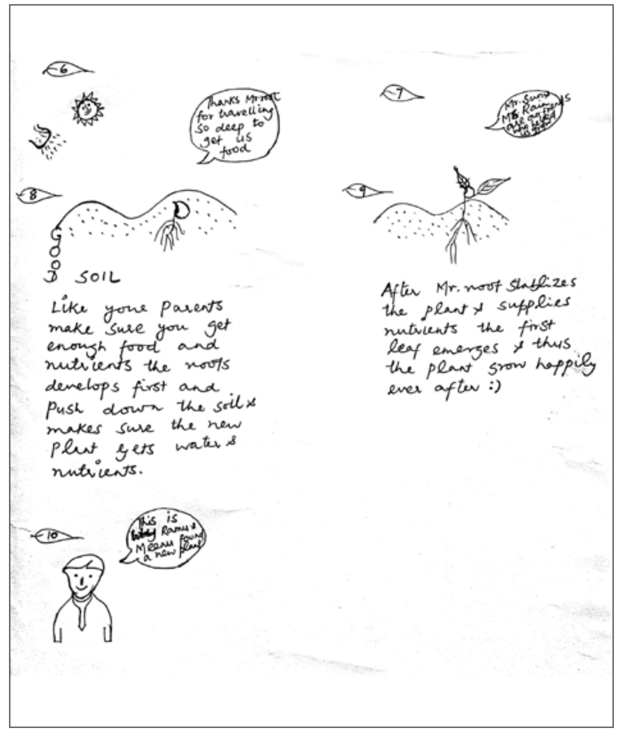
**Time estimate:** Less than an hour when you have a rough concept in mind

**Method:** After deciding on the story, divide your sheet into boxes and doodle your story step by step in each box. You may choose to write the story in words below each doodle or make the children do that.

A representative story board on germination of seeds:

I have created a story board on germination of seeds to give an idea of how a science story board can look. Though I have created it in a sheet, drawing, each step in a separate piece of chart would work better.




*A storyboard for the germination of seeds*

The concepts like hard seed coat and soft seed coat can be demonstrated with corn and tomato.

This technique can also be combined with experimental teaching technique for a better impact. For example, at the end of the story, the teacher can ask the students to sow their own seeds and let them experience what they have learnt.

Since visuals & stories are something that attracts children and are close to them utilizing it for teaching 'supposedly' tough subjects like science would be a smart teaching step.

***References:***

1. www.billwood storyteller.com
2. https://en.wikipedia.org/wiki/Germination

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# Why TLM – Its Aims and Uses

**Swati Sircar**

Any effective pedagogy for teaching mathematics to children must include materials, especially when new topics are introduced at the elementary level. There are three reasons for the above:

First, all concepts in mathematics are abstract. The concepts form in our minds slowly over time. As we play with concrete materials, our minds gradually grasp the general concepts related to numbers and shapes arising out of the concrete examples. So at the elementary level every new concept should be introduced with concrete material or manipulatives. We will give examples of manipulatives for teaching various aspects of whole numbers and how they link to algebra.

Second, mathematics includes a lot of conventions as well as rules, in particular in how we write numbers. Conventions, which have no logic as such, can only be learned through association.

Manipulatives help establish that association much more strongly than chalk-and-board or drawing because these things can be moved around. So they not only give visual input, but also tactile and kinaesthetic ones to the brain and thus help in creating associations. This is as true for learning place value and then using it for various operations as for algebra or geometry.

Third, math in particular tends to build up i.e. the concepts are organised in the hierarchical manner. So any lack of understanding at any level creates a big hurdle for further learning of concepts which depend on those at the previous level. For example, poor understanding of place value heavily impacts how well a child can (or rather cannot) master algorithms for addition, subtraction, multiplication and division with multi-digit numbers. The use of manipulatives builds a strong foundation that facilitates further learning. We will give one of many examples of one material that help decipher algorithms.

Example 1: The *ganitmala* [see Fig. 1.1], a mala of 100 beads in two contrasting colours alternating in groups of tens, is a great proportional material that makes such an association. This *mala* is basically a manipulative version of the non-negative number line. So beads are counted off from the left since the zero is to the left of all positive numbers in any number line. So when we show twenty five in the *ganitmala*, the twenty, or two tens, are on the left and the five, or five ones are on the right.


*Figure 1.1*

This is exactly how we write twenty five as

| T | O |
|---|---|
| 2 | 5 |

the 2 indicates how many tens, while the 5 is the count of the remaining ones. However, the order of writing tens on the left and ones on the right is only a convention. A curious child may ask why the tens are written on the left. The *ganitmala* demonstrates that the tens are on the left – an association that cannot be provided by bundles and sticks, which can be placed in any order.

The *ganitmala* can be used for introduction and comparison of numbers, as well as all four operations, so long as the numbers are within 100. It can also be used to find HCF. For integers, double *ganitmala* – with 200 beads in four colours can be used. Two more colours are needed for the negative part of the number line. This can be used to solve most equations with integer coefficients and with the variable (or unknown) appearing only once. Interested readers may look into the references below on double *ganitmala* for further details.

Example 2: Flats-Longs-Units (FLU) or 2D base-10 blocks:

These include bigger squares split into a 10 × 10 grid denoting hundred, 10 × 1 rectangles denoting tens and small squares denoting ones [see Fig 2.1]. The colour in all of these should be the same since the 10 pink ‘ones’ (units) should add up to a pink ten (long) and 10 pink tens should add up to a pink hundred (flat). If, for example, the colour is

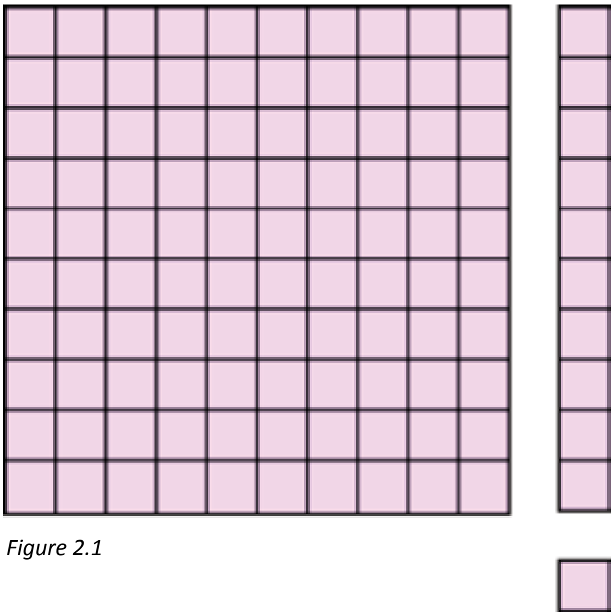

*Figure 2.1*

changed from pink to yellow that may be confusing for children. This is a very powerful teaching material that basically deciphers almost everything related to whole numbers (up to 3-digits) including algorithms in particular. It can even help finding the division algorithm for finding square roots!

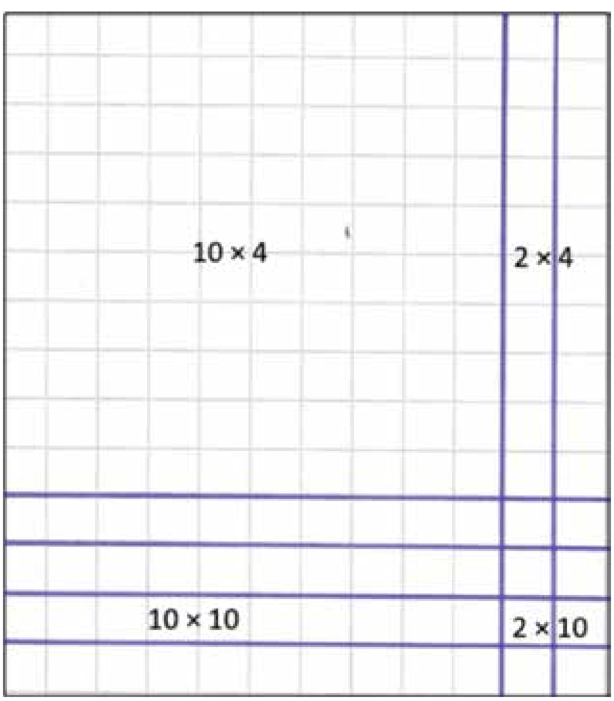


*Figure 2.2*

Incidentally, no one sells this material – at least not enough of it. To do all kinds of division problems within 3-digit numbers, each set should have at least 90 longs and 90 units. This takes care of most multiplication as well. We recommend 15-20 flats in each set. Sheets from square grid notebooks can be used for making this material. From each such sheet usually a hundred come off from one corner. The remaining reversed L shape should be harvested for longs and the corner of the L provides units. The layout for any such sheet is essentially a multiplication in disguise (see Fig. 2.2 representing 12 × 14).

This is completely in line with the grid multiplication included in several textbooks including NCERT.

The advantages of this layout, and FLU in general, carries over to decimals. Since children are older by then, graph papers are used along with colouring. For example:

In a centimetre graph paper, 10cm × 10cm square should be taken as 1.

So one-tenth of that, or 0.1, is a 1cm × 10cm rectangle.

Similarly 0.01 can be a 1cm × 1cm square or a thin 1mm × 10cm rectangle.

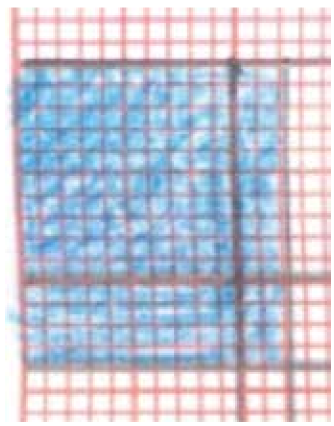

*Figure 2.3*

0.001 is a 1mm × 1cm rectangle while 0.0001 is a tiny 1mm × 1mm square.

Now 0.12 × 0.14 becomes a miniature version of the earlier 12 × 14, thus making decimal multiplication a piece of cake.

The miniaturisation also aids in understanding that 0.12 × 0.14 is nothing but 12 × 14 divided by 100 × 100 which actually is a standard algorithm [see Fig. 2.3].

This stretches all the way into algebra. The FLU gets generalised into algebra tiles with two differences –

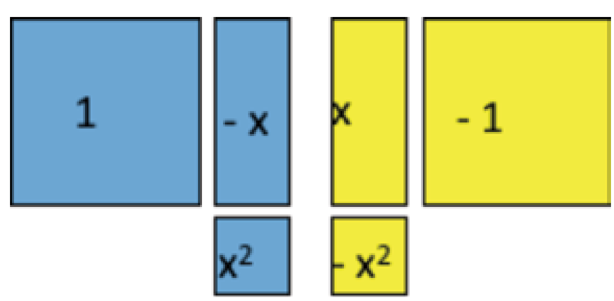


*Figure 2.4*

(i) The dimension of the rectangle (and therefore the ratio of the sides square) opens up from a fixed 1:10 and

(ii) Everything, i.e., big squares, small squares and rectangles are in two contrasting colours (which can be either double sided or two separate sets) representing positives and negatives [see Fig. 2.4].

(iii) The same layout continues for (x + 2)(x + 4) and with colour variation accounting for negativity for (x + 2)(x – 4), (x – 2)(x + 4) and (x – 2)(x – 4) [see Fig. 2.5]. In each i.e. whole numbers, decimals and algebra:

- The small squares are together – if bigger numbers like 32 × 54 or (3x ± 2)(5x ± 4) are used, the reader will be able to see that the big squares also stay together

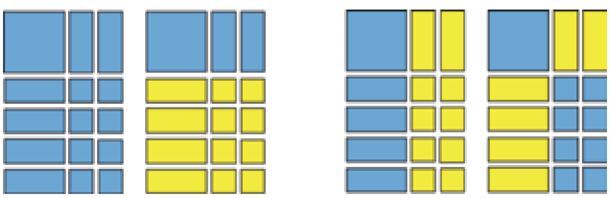

*Figure 2.5*

- The big squares and the small squares occupy opposite corners
- The rectangles are always in two parts in the remaining corners

A child familiar with FLU will naturally identify many such common patterns in algebra tiles as well. In fact, a lot of Vedic *ganit* can be explained with FLU. Certain notations can be understood better with FLU in two colours – positive and negative – like algebra tiles!

The best part of algebra tiles lies in understanding the colour patterns in the four examples shown above and using them to crack middle term factorisation. The reader can refer to the links at the end and is encouraged to explore further.

Example 3: Ten-frames with counters:

Ten-frames are 2 × 5 grids of 10 squares which are, used along with round counters. Ten-frames can be easily made from any card type materials including boxes, while buttons can be used for counters.

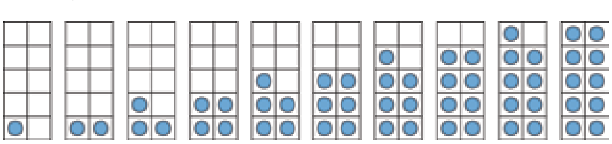

*Figure 3.1*

Numbers from 1-10 can be represented as follows using ten-frames and counters [see Fig. 3.1].

What jumps out is the alternating pattern – (i) an odd one jutting out at the top and (ii) level or even top. That is basically ‘odd’ and ‘even’! Notice how this arrangement automatically connects the common use of ‘odd’ and ‘even’ to their mathematical meaning with respect to natural numbers. One can ask whether zero should be odd and it can be argued that since it does not have an odd counter jutting out it can’t be odd. So it has to be even.

At this step, if an even number is added to another even number, then the top of the sum is level. If an odd number is added to an even number, then because of the odd number the top of the sum becomes non-even, that is, the total has an odd counter at the top, so it becomes odd. But if two odd numbers are added then the parts which jut out compensate each other by fitting together and we get an even number as a sum.

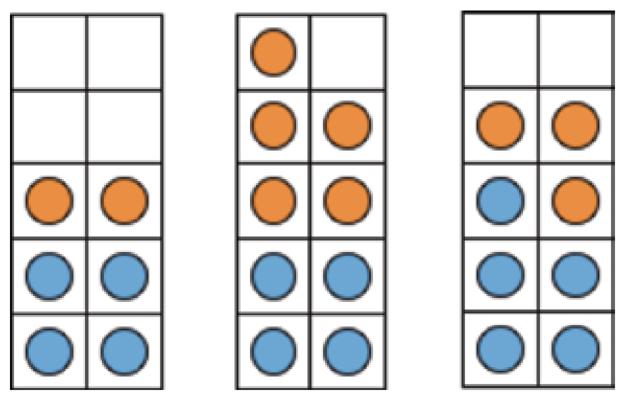

*Figure 3.2*

This visualisation of even and odd numbers [see Fig. 3.2] not only helps children understand the terminology, it also helps them figure out what happens when these numbers are added together.

Again does zero behave the same way as the rest of the even numbers, that is to say, is the sum of zero plus an even number itself an even number? Can zero plus an odd number result in an odd number? This solidifies the case for zero being an even number.

The story does not end here!

The next step is understanding what happens with bigger numbers.

Before going into 3-digit numbers, a

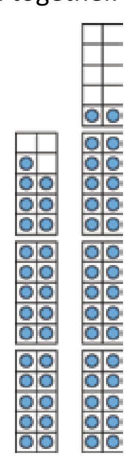

*Figure 3.3*

child learns that any 2-digit number is made of tens and ones. So, using ten-frames, a number like 27 or 32 looks like this [see Fig. 3.3]. Since ten is an even number, several tens put together is still going to remain an even number. So the number of tens do not contribute to the oddness or evenness of a number: it is the number of ones, that is, the unit's digit determines if a number is odd or even. Since hundreds are made of tens and the same applies to thousands as well as all higher place-value units like lakhs and millions, the same technique works for any natural number, no matter how many digits it has. In all cases, we can just look at the unit's digit and figure out whether it is odd or even.

Is the above different from a more formal definition: An even number is a number that is divisible by 2, or one that can be written as 2n for some n = 0, 1, 2, 3, 4 …? Or that an odd number is any number that is not divisible by 2, which leaves a remainder of 1 when divided by 2 or that can be written as 2n + 1 for some n = 0, 1, 2, 3, 4…?

The reader could think, well isn't n = 3 for odd number 7 and even number 6? What do you think n is for 11 or for 26? In light of the visualisation mentioned above, n is nothing but the common height of both columns. It is also the quotient of the number divided by 2 while the number which is jutting out is the remainder, which of course would be missing for even numbers.

Also the algebraic proof of odd number + odd number = even illustrated as $(2m + 1) + (2n + 1) = 2(m + n) + 1 + 1 = 2(m + n + 1)$ is clearly illustrated by the ten-frame visuals. For any child familiar with the ten-frame visuals, it becomes so much clearer and meaningful. Whereas otherwise it can be just some algebraic jugglery with symbols which may be too scary to touch. The reader is encouraged to make similar connections for even number + odd number and even number + even number.

Ten-frames have other uses as well and we strongly encourage the reader to explore them! They are particularly helpful for various automatisations which aid learning.

Up to Class 10, mathematics is a compulsory subject for every child regardless of his/her inclination and/or proficiency in it. Teaching materials as aids help most children understand better and while giving a lot of food for thought for the mathematically-oriented. Hence most textbooks nowadays, including the NCERT ones, mention a whole range of materials. However, teachers are often not so familiar with them and may not have seen them outside textbooks. So much remains unexplored and not utilised.


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- Dhankar, R: Teaching and Learning of Mathematics https://azimpremjiuniversity.edu.in/SitePages/pdf/The-Teaching-and-Learning-of Mathematics.pdf
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- Double *ganitmala*:
  - Intro to integers: http://www.teachersofindia.org/en/presentation/integers-ganit-mala
  - Comparing integers: http://www.teachersofindia.org/en/presentation/comparing-integers-ganit-mala
  - Adding integers: http://www.teachersofindia.org/en/presentation/addition-ganit-mala
  - Subtracting integers: http://www.teachersofindia.org/en/presentation/subtraction-ganit-mala
  - Initiating equations: http://teachersofindia.org/en/presentation/solving-equations-ganit-mala
  - Simple equations: http://teachersofindia.org/en/presentation/solving-simple-equations-ganit-mala
  - Complex equations: http://teachersofindia.org/en/presentation/solving-complex-equations-ganit-mala
- FLU in multiplication: http://teachersofindia.org/en/presentation/initiating-multiplication
- Algebra tiles:
  - Demo: http://www.youtube.com/watch?v=4AwXOibqGxI
  - Practice: http://illuminations.nctm.org/Activity.aspx?id=3482



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# Teaching Learning Materials to Understand Some Geographical Concepts

**Tapasya Saha**

### Understanding the true shape of the earth

The earth is defined as being round but in fact the true shape of the earth is described by the term *Geoid* which means the Polar regions are flat while the Equatorial region bulges out. The spinning of the earth develops a *centrifugal force* which forces the mass to spread out while simultaneously another counterforce, the *centripetal force* comes into play. Both the forces work in a coordinated manner. The centrifugal force throws out the mass, thereby creating a space around the central part of the earth. Consequently, the mass in Polar regions tend to fill up this space or vacuum. This causes the Polar regions to be flat. This is because the rpm (rotational speed per minute) of spinning is slower at the Polar regions when compared to the Equatorial region.

### Model-1: Understanding the effect of the earth's spinning on its shape

Things needed: (Refer to Diagram 1)

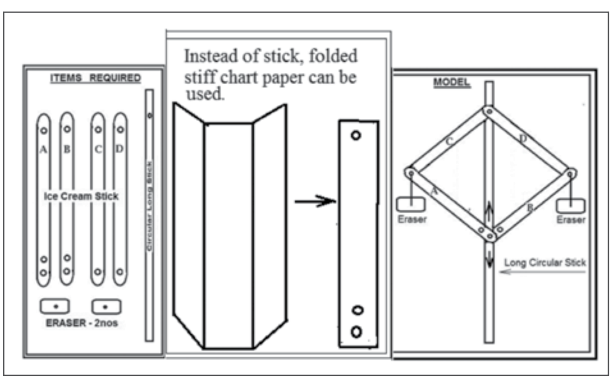



*Diagram 1*

Four ice cream sticks – A, B, C, and D - each 11cm in length; one smooth wooden stick -30 cms. in length; two erasers; strong thread to tie the ice cream sticks.

Steps:

1. Make two holes at each end of the ice cream sticks A, B, C and D, Make one more hole in both A and B, close to the hole already made. The space between two consecutive holes in A and B should have a distance of little more than the diameter of the wooden stick so that the rod can rotate freely, when tied with the ice cream sticks.

   Make holes in the centre of the two easers as well as at the top of the wooden stick.

2. To attach the wooden stick with the two ice cream sticks C & D, put a thread through the holes of the wooden sticks, C and D and tie a knot firmly so that it is fixed. Tie C&A and D & B with threads.
3. Use a longer thread now and take it through the two consecutive holes of both A and B. While doing so place the wooden stick carefully between A and B and tie loosely. Remember that the ice cream sticks should freely go up and down along the wooden stick.
4. Loosely tie A & C. as well as B & D. Put slightly longer threads through the holes of the erasers. Hang the erasers from the junction of A & C and B & D. Erasers must hang freely.
5. Spin the wooden stick now in one direction moderately.

What do you see?

Due to the centrifugal force, the erasers representing the mass of the earth move away, while the polar mass moves towards the central part (equatorial region) bringing the sticks closer towards each other. Refer to Diagram 1, given above.

### Understanding the inclination of the Earth's axis at an angle of 23 ½$^0$

It is always found in textbooks that the earth is inclined at an angle of 23 ½$^0$ to its orbital plane. This phenomenon is hardly ever explained. To me teaching is complete only when the learner can visualise what the concept means: in this case learner must visualise how planets and the sun are positioned in the orbital plane. And how the angle of inclination is measured.

The learner must remember that a plane has a perpendicular. To understand this, consider:

i) the earth in an upright, not inclined position

ii) the orbital plane as one to be passing through the equator of the earth

iii) the perpendicular to be an imaginary line passing through the centre of the earth, North Pole and South Pole, coinciding with the upright axis of the earth. Refer to Diagram 2.

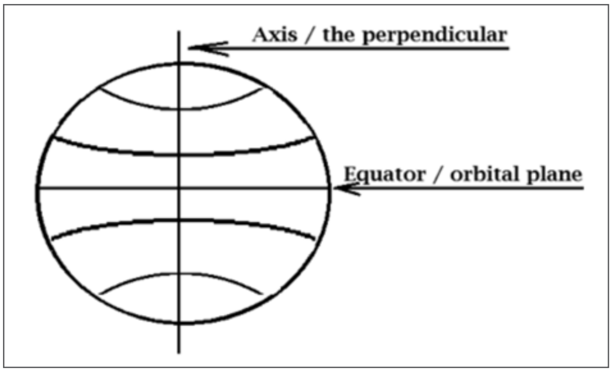



*Diagram 2*

The earth is tilted at an angle of 23½$^0$ from this perpendicular of the ecliptic or the straight line passing through centre of the earth and the poles. To visualise this lets make a model.

**Model 2**

**To show the orbital plane, the position of the sun and the earth in this plane (not to scale) and the inclination of the earth's axis**

Things needed: (Refer to Photographs 1a, b, c)

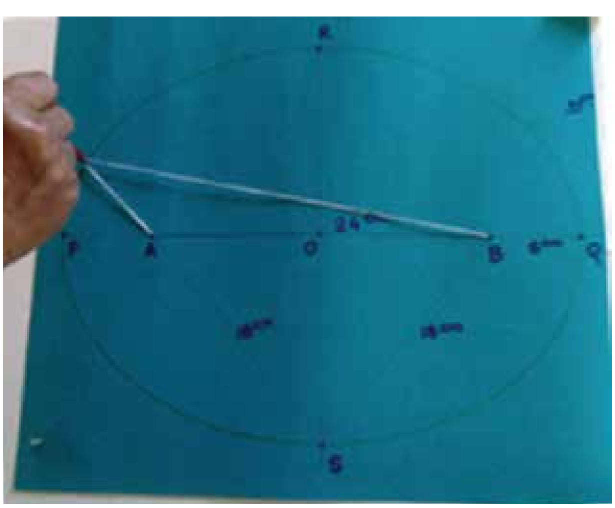
I. A rubber ball cut into half, represent the sun.

II. Another similar ball of any different colour representing the earth.

III. Two sticks, one black, the other white.

IV. A KG cardboard- 35×40cm

V. 36 cm thread, needle, pencil, ruler



*Photograph 1a*

*Photograph 1b*

*Photograph 1c*

Steps

1. Take the earth ball and slit it halfway horizontally. Hold the earth in an upright position and pass the black stick through O&P, passing through the centre of the earth. This black stick now represents the perpendicular. Measure 23½$^0$ from the perpendicular at point T and pass the white stick through this point. (Photograph 1b)

2. Drawing of the orbital plane

   Take a piece of KG cardboard 40 cm by 35cm. Draw a straight line AB 24 cm in length, at the middle of the paper. To make an elliptical arc, take a thread and fix each the ends at A and B respectively. Now insert a sharp pointed pencil in the loop created by the thread. Move the pencil around points A & B; keep the pencil tight to maintain the tension throughout and draw the ellipse. This is the orbit of the earth around the sun. (Photograph 1a)

Point A will be the position of the sun and position of the earth will be close to point B-Q, along the edge. (Photograph 1c)

**Demonstration in class**

Now the critical part: with your left hand hold the sun (in two parts) half on the top of the plane of orbit and the other half below it. Position the sun at point A and the earth near point B-Q. Very carefully insert the slit in the earth ball, into the edge of the plane.

This model will clearly show:

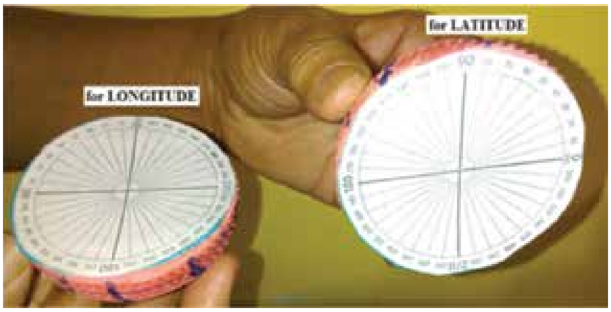
- The position of the sun and the earth in the elliptical plane of ecliptic.
- The tilt of the earth at an angle of 23½$^0$.

**Understanding the angular measurement of latitude and longitude**

Students of geography are always taught to draw the important lines of latitudes and longitudes on a circle representing the earth, followed by numbering them. While some books say that these are angular measurement, that is an incomplete explanation.

**Model-3 (i): To explain how the latitudes and longitudes are measured**

Things needed: (Refer to Photographs 2a and b)




*Photograph 2a*


*Photograph 2b*

1. Take two balls, cut into halves to get four hollow hemispheres.
2. Two printouts of paper protractors of 360 degrees, matching the circumference of the ball- hemisphere.

Measuring latitude

Steps:

1. Paste a 360$^0$ paper protractor on a hemisphere, holding the hemisphere in a vertical position, so that 90$^0$ is at the top and 270$^0$ at the bottom. Mark 0$^0$, 30$^0$, 60$^0$, 90$^0$ (only a point) on the vertical periphery of the hemisphere. Join this one with the other hemisphere; insert a bamboo stick, which represents the axis of the earth, through the centre vertically and extend the already marked degrees on the vertical periphery making complete circles, representing latitudes of corresponding degrees.

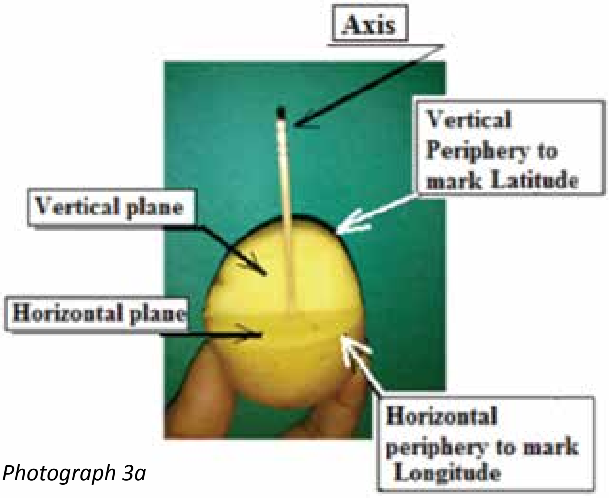
Measuring longitude:

2. Paste the 360$^0$ protractor on a hemisphere holding the hemisphere horizontally so that 0$^0$ should be at the top and 180$^0$ at the bottom. Mark 0$^0$, 30$^0$ E, 60$^0$ E, 30$^0$ W and 60$^0$ W along the horizontal periphery of this hemisphere. Put the other half of the ball on top covering the paper protractor. Insert the bamboo stick through P and O, representing the axis of the earth. Extend the already marked degrees on the horizontal periphery towards the zenith and nadir meeting at P & O, representing the longitudes.

**Model 3 (ii)**

**To show that the angular measurement of latitude and longitude is the inter-section of horizontal and vertical planes**

Things needed: (Refer to Photographs 3a and b)




*Photograph 3a*


*Photograph 3b*

1. A medium sized potato.
2. Three toothpicks, one red and the other green

Steps

1. The potato represents the earth. With a sharp knife make a vertical and horizontal slits to out a quarter of the potato. At the mid-point of the intersectional line, created by the vertical and horizontal slits, fix a toothpick vertically. This represents the axis of the earth.

**Longitude:** Align a green toothpick along the line from the centre of the earth and $0^0$ horizontally. This represents the reference line for measurement of longitudinal angles. Measure $30^0$ by moving the toothpick clockwise from the reference line of $0^0$ horizontally. This angle is a longitudinal angle.

**Latitude:** Similarly, place a red toothpick as stated above, move this stick upward/anticlockwise to $30^0$ from the $0^0$, the angle formed by the stick with the same reference line is the latitudinal angle.

In both the cases the measurement of angles are estimations only.

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# Chakmak - Sparking an Interest in Reading and Learning

Vinatha Viswanthan

*Chakmak is a monthly science magazine in Hindi for children between the ages of 10 and 14 years. Conceived by Rex D'Rozario and Vinod Raina, it was launched in 1985. The idea was to encourage children to read, and in general, to supplement what they learnt at that age in schools while making it an enjoyable process. Chakmak at that time contained a fair amount of science in addition to stories, poems and pictures. The science was presented in diverse forms to hook readers, to encourage their creativity and encourage independent thinking. Poems, stories and illustrations by children were also published in each issue which helped children identify better with the magazine.*

*In over three decades, Chakmak has seen many changes. However, its broad goal remains – to be a supplementary reader, allowing children to read a wide range of topics while ensuring the process is enjoyable.*

The idea of a science magazine for children was not a novel one for those involved in the Hoshangabad Science Teaching Programme (HSTP), a path-breaking initiative that began in the '70s. *Bal Vaigyanik*, the science workbooks for middle school children, were written in Hindi. Also, a pedagogy that was unique and way ahead of its times was introduced in the schools that were a part of HSTP. The curriculum did not dish out information, but made the same topics covered in mainstream textbooks, enjoyable. The content was in the form of activities and questions, encouraging experimentation, data collection, comparison, scientific thinking, and it helped children understand diverse concepts by making science-learning relevant and fun. *Bal Vaigyanik* helped children (and teachers) think, want to know more, discover the magic of exploratory learning.

This curiosity, an eagerness to know more about science had little recourse at that time. It was unlikely that a child in rural Madhya Pradesh had access to a reference library with books he could understand.

Thus was born *Chakmak*. Created for the *bal vaigyaniks*, 11-14 year olds were the target readers. It was meant as supplementary reading, specifically science reading for them. At that time, a Hindi science magazine for middle school children was an empty niche. Even now, there are few magazines with such a focus.

Look at the early *Chakmaks* and you can see that although science was a focus of the magazine, there were also articles on topics other than scientific ones such as current issues, social causes, articles on personalities, stories and poems. There were also several regular features or columns in the magazine. From the beginning, the magazine had *Mathapacchi*, where children were given puzzles to solve – both word and pictorial. The idea was to nurture a problem-solving attitude in readers. Then there was *Sawaliram*, a fictional character of whom a child could ask any question and be assured of an answer. *Sawaliram* was known at all the schools in which HSTP was being implemented. Dozens of postcards and letters would arrive for him every week, and in answering those, the *Eklavya* and *Chakmak* teams would often rely on the expertise of the finest minds in science in the country. For some of the questions were extremely challenging even if deceptively simple.

And then there was *Apni Prayogshala*, where by following some relatively simple instructions and using material almost any child would find around her, she would be able to put together something interesting, observe a phenomenon that she could wonder about in her leisure. Finally, there was *Mera Panna* – pages where children's poems, stories and illustrations would find place. Children's work always was prioritised, often on the cover, sometimes illustrating an article or story. In addition, there were crosswords, picture stories, *Khel Khel Mein*, jokes – several things that keep children hooked and happy. *Chakmak* was a *pitara*, a treasure trove for children.

As for the style and presentation of the content, there was a concerted effort not to be condescending to children. The style of writing was one where children were not talked down to. The illustrations and design of pages, from the beginning, were in diverse styles which included 'tribal' styles such as that of Jangadh Singh Shyam. Moving away from childish cartoons, good art for children was favoured. In general, whether it was with regard to the text or the illustrations and design, children were treated as equals to others.

At that time, with HSTP in full swing, with constant and continuous contact with children, the editorial team of *Chakmak* had a finger on the pulse of what children wanted to read in a science magazine. *Eklavya* people going to schools for HSTP follow-ups, for monthly meetings all carried bundles of *Chakmak* to be sold to children at subsidised rates of Re. 1 or Rs. 2 per copy. Often teachers at these meetings volunteered to reach the magazines to the students of their schools. Children also wrote to *Chakmak* quite frequently. Questions for *Sawaliram*, contributions for *Mera Panna* helped the makers of *Chakmak* know how children received it. At that time, teachers used *Chakmaks* in the classroom to discuss diverse topics, to do some of the activities in the magazine. So, *Chakmak* got constant feedback from the teachers as well and was being the supplementary reading-learning material it was intended to be.

A few years later came the *Chakmak* Clubs. *Chakmak* Clubs were children's clubs that were meant to be meeting points for children. While they took their name from the magazine and the magazine was read and discussed there, the magazine did not conduct these clubs. The clubs were over a hundred in number and were run by the children and youth at a location. Readings, narrations, discussions, music and fun were a part of these clubs. Here again, *Chakmak* was used so children would read widely. In the process, they would learn something from the magazine, and more importantly, from each other. *Chakmak* was the spark for many a heated discussion.

A look at the first decade or so of *Chakmak* issues and you will find it to be mainly a 'how and why' magazine. This was an important style of presentation as it reflected the approach of *Eklavya* to education to be explanatory, in a fun and authentic manner. At this time, the issues and topics covered in *Chakmak* were those of both the urban and the semi-rural middle class. The readers however, were mostly children in the semi-rural Hindi belt.

In the late '90s, when the primary education programmes in schools began receiving more attention, *Chakmak* reflected this change in focus by including material for early readers such as short prose and poetry. All through these first ten to fifteen years, *Chakmak's* focus remained on science and its reach mostly included children in government schools and in non-urban areas.

This changed after about two decades or so. *Chakmak* began carrying a little less science. The change was for several reasons. One was that HSTP came to an end around this time. Another was a change in the editorial team. A new team with different expertise meant a different kind of *Chakmak*. Another reason was the realisation that, while as an organisation *Eklavya* had contributed to some extent to making science (and other subjects) more accessible to children, had developed a lot of material (including that in its magazines) in popularising these subjects, there was a great paucity in material in Hindi in children's literature. In fact, there was and still is, very little that constitutes the field of children's literature in Hindi. To some extent, we think of children's literature as that which is written for children. With this in mind, *Chakmak* began working with well-known (and not so well-known) authors to develop literature, including stories and poems for children. *Chakmak* became a platform for all those who had an interest in writing for children. At this time it also shifted from black and white to complete four-colour printing and being professionally designed.

*Chakmak has always served as a rich resource of material for Eklavya's other publications. Collections of poetry, kavita posters, kavita cards, collections of stories have all been developed based on material first published in Chakmak. Examples include a collection of stories put together from submissions to Mera Panna such as Azadi ki Nukti and Lomdi aur Zameen. More recently, some stories from Chakmak have been published as picture books such as Patank ki Karamat, Saanp ne Socha, Hamari Gay Jani, Mujhe Koi Nahi Khilaya, Baitha Aas Lagaye. Currently, Eklavya is developing a collection of stories published by young adults in Chakmak. It can be said that literature written by children has come of age with Chakmak.*

From the late-2000 onwards, *Chakmak* was published in this new avatar. More of fiction, more *Mera Panna* and a little less of maths and science. By this time there was another change – this was in *Chakmak's* reach. It shifted out of government schools and rural semi and non-urban areas to private schools and urban areas. The target age group also shifted gradually upwards during this phase – and now *Chakmak* catered more to high school children in addition to those in the middle school age group. To a large extent, *Chakmak's* content was being developed with these children in mind – their literacy levels, topics and issues relevant to them and their pockets as well. The schools in which *Chakmak* was used in the classroom were private schools. Children were being engaged in several ways, through activity columns, the column *Boli Rangoli*, where the poet Gulzar would give a couplet in one issue and children would send in their illustrations of it for the next. In another column *Agar-Magar*, they would ask Gulzar questions and he would answer them often in rhyme, frequently in a whimsical fashion. Young adults were being encouraged to write, a body of literature for this age group began to be developed via the column *Chashma Naya Hai* in collaboration with Ankur, an organisation in New Delhi. In collaboration with an organisation involved in conservation, Nature Conservation Foundation, a series of articles and activities on nature were translated and published. There were experiments with format – a serial picture story *Biksu*, novels presented as a series, characters that made their appearance in several issues like *Ramsahay* and so on.

All through, *Chakmak* continued to be fun and supplementary reading material for school children with a potential to be used in the classroom.

So, over the years, there have been three groups of people who have used *Chakmak*. The first is the children for whom we make *Chakmak*. They have fun reading and learning from it. Historically, two other groups also have benefitted from *Chakmak*, though we have not made the magazine with them in mind. One is that of resource persons in diverse organisations working with children who have used the magazine's material to engage children in various ways. The other is teachers who have used *Chakmak* in classrooms to read from, and to also discuss and answer questions asked in the magazine. In this way, *Chakmak* always has been and continues to be a fun magazine for children and a resource for children, teachers and others in the field of literature and education.

*Based on conversations with and inputs from Sushil Joshi, Tultul Biswas and C.N. Subramaniam.*

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# Toying with Teaching-Learning Materials: Early Years of Learning

Vinita Jaiprakash Abichandani

Four year old Gangesh fitted some pieces of coloured plastic blocks into each other and pushed the completed structure through the school premises. It had a body and an elongated structure in the front. While the other children drew or made fish and flower, we thought this was an elephant.

But negating our view of it, he assertively declared that it was a track-hoe! (Fig. 1)

*Figure 1: Gangesh's track-hoe*

His track-hoe needed no wheels, it could move when Gangesh pushed it, but its digging power had caught his attention. He moved the front of it up and down into the ground when asked to explain how it was a track-hoe.

Toys and games have generally been associated as gifts and children's playthings at home and in the family. With the general concept of children learning or getting something useful from the material gifted or given to them, toys and games become agents or medium of learning. Bringing the children from home to school, toddler classrooms usually are equipped with what could still be termed as toys for guided learning. These may have been implanted to ensure development of sensory and motor skills, problem-solving skills, comprehension of cause and effect and symbolic thinking. Accordingly, either the material is designed to suit Piagetian stages of growth and/or fit well into the context of the growing child (Guyton, 2011) (Montessori, n.d.).

However, as in the case of Gangesh, Brian Sutton-Smith in a study observed that children have a personal narrative attached to toys or material they use. He highlighted that the creative capacity of the child is not limited to the toy-stimulus provided to it (Sutton-Smith, 1992). There are prior mental processes and ideas of the child that play a role in how it perceives the object of play.

Toys then may act as a resource for teachers in class in the early years of learning but a child may be perceiving it differently.

Dineshwari ma'am, a teacher of students in the age group three to five, looks forward to preparing them for grade one. She suggests that toys for children should be bigger in size and easy to handle and cost-effective. While her store house of playthings for kids had a variety of objects, she stated that plastic is the best material that could be used for objects of children's learning since it would not harm them and would not break easily. I understand her need for unbreakable material, but my observation of an instance brought to fore another important aspect of a child's thought process.

I attempted getting children's views and understanding of animals on field, through material other than the textbook, and the use of child-centred approaches through toys and games to trigger the child's imagination and creativity (NCF, 2005).

On a festival called *Pola* in Chhattisgarh, bullock -like toys in wood and clay make appearance in the market. I had handed these wooden as well as clay bullocks to the children. While most identified clay bullocks as bullocks based on its appearance and shape; some were of the opinion that the wooden version was a dog. When asked the reason for their choice, a couple of children said that because the model was smaller and lighter (Fig.2)

Two things: the weight and size of the material concerned and the difference that arose from sound in the wheels of the two, seemed interesting here.

*Figure 2: Bullocks made of clay (top) & wood (below)*

The wheels of clay bullocks had small pebbles in them which made a peculiar sound when the bullocks were played with, whereas the wooden wheels had different and a comparatively fixed sound. For the children, the sound made against the clay wheels by the pebbles from within was that of a cow-bell or the belts they are put around the bullocks that they own. Here, I discovered the child's potential to interpret material based on its abstract and more detailed qualities than what may be expected of them. It created a stark difference between how I looked at both the objects as bullocks from an already informed idea of it and how children could construct their own representation or *signification* of it for themselves (Mohd. Yakin & Andreas, 2014).

*Figure 3: Gangesh's water tank made of wooden blocks, the wooden lid (1st part) and place to store water inside the hollow (2nd part)*

In another instance, while Gangesh and a friend of his would agree on making a track-hoe or a train from plastic blocks, they would make a house or a water tank with blocks of wood. These blocks could not be fitted into each other, but could be placed and balanced on each other. This gave me an insight into their idea of the process of constructing and building. Additionally, when asked about where would the water be stored in the water tank or how people would enter the house, since the it had two openings, these two boys could give specific answers by opening a wooden lid for the water tank and pointing inwards through a bigger opening in the house like structure (Fig. 3)

It is of interest here to look at the signifying or the semiotic function of toys which are learning materials in early and primary levels of education.

Semiotics is the study of the physical and the linguistic world through which the linguist Ferdinand de Saussure called signs. For him, language is a system of signs. These signs create a reality for us through the signifier (the sound-image) and the signified (the representation). Both the signifier and the signified are inseparable and complement each other to fill a sign with meaning for which it stands or it represents (Mohd. Yakin & Andreas, 2014).

Brian Sutton-Smith attempted to view the semiology or the signification of toys i.e. the sound image an object could make in a child's mind and accordingly what would it stand for. In his study he cautions us about toys or learning materials that mimic the original or real objects. In his view, the toy or a plaything in itself is meant to depart from the original giving more space in its interpretation to the 'resident fantasies within the player's experiences' (Sutton-Smith, A Toy Semiotics, 1984).

P.J. Miller rightly said that an object 'must not be analysed only by the determinant rule-based objectivist procedures, since as an instrument of social strategy it retains a high-degree of flexibility' (Gongoulis, 2003). The child attempts an internalisation or appropriation of an object at hand, re-contextualising it with personal meaning.

Basing his argument on the importance of the flexibility and the malleability of the material used for playthings for children, Roland Barthes, a French linguist stated that substances like plastic and metal are removed from the 'humanity of touch', while wood is 'firm and soft… a poetic substance'

(Barthes, 1957), it does not break at once but it wears out modifying its relationship with the user over time.

This makes me think whether the toy has got 'hurt', while if it had been *plastic* it would never die, but might be thrown away.

During my practice in grade 4, when we made dolls out of socks and paper, it was not a doll for this one girl. It was me. To get her understanding of body parts right, she had identified my body with that of the doll and put a *bindi* and earrings on it. More so, this doll made out of flexible material like cloth, cotton and rolled paper helped the child bring it to life. Unlike her previous activity of drawing me into a static picture, this dimensional doll allowed her to work and re-work on how she looked at me from time to time (Fig. 4).

*Figure 4: Doll made of socks, paper and cotton (to the left); different earrings, bindi, eyes could be used for the same doll*

*Figure 5: Children arranging coloured pebbles on alphabets in Hindi*

An even more fascinating instance of how properties of learning material may support the child's attempt to make meaning out of it came to my eyes when a group of children not only used chalk to write the Hindi letter 'अ' on the floor but arranged coloured pebbles through its shape and made it a reality for themselves (Fig.5)

Finally as an adult 'toying' with teaching-learning materials for effective toying of it by the child - the material should be for constructive play allowing for playful construction and not mere construction (Forman, 1998); making the child not only its owner and user but also the creator (Barthes, 1957).


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