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### Scientific Development of Teaching Learning Material (TLM): Interface between Higher Education and Primary Education.

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Teacher Education is essentially a component of higher education institutions. Teacher Education as well as special teacher education is the responsibility of the colleges and the university system. Where teacher education or special teacher education is not directly linked with the college and university system, it still gets its theoretical inputs from the knowledge constructions and research innovations, research discoveries as well as research related inventions emerging out of higher education system. The school system, at large, does not generate its own knowledge conceptualization but rather implements what has been generated at the higher education level. For any teacher education program either in regular or special education, the school system acts as an important laboratory. In contrast to teacher education departments, other disciplines have their own laboratories generally present on the campuses or in the departments, where the teaching learning processes and research take place. Whereas, generally the teacher education departments have their laboratories in the form of schools and communities away from their campuses or the departments in the colleges and the universities.

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It becomes the social responsibility of the higher education system in general and teacher education and teacher special education in particular to see that the research generated gets translated into practice at the school level. The present paper attempt to highlight that the theories related to education taught at the higher education level are often in isolation with the pedagogical outputs being used at the school system. This often leads to non suitable teaching learning material (TLM) and hence leading to limited or inappropriate learning in the school going child. This gets even more highlighted in the case of children with disabilities. With the changing government focus towards inclusive education, it is important that the linkages between education related theories, pedagogy and teaching learning material needs to be developed in such a way that not only atypical child in the classroom but also the child with disabilities is able to reach ones potential in an inclusive classrooms. Higher education research needs to work towards facilitating a particular teacher to be able to reach out to all the children with the support of appropriate scientifically evolved teaching learning material.

The study has tried to develop pre requisites towards the teaching of certain primary school concepts supported by the theoretical concepts and theories evolved at higher education levels.

The learning of any concept is based on the understanding of the pre-requisites it is based upon. If any one of the pre-requisite is not assimilated by the learner, the next concept development will be affected. The pre-requisites act as building blocks for the concept formation. However the pre-requisites for any particular concept formations are not always in a chain like hierarchical order. The concept formation may also take place in a seemingly haphazard, deep down a network which moves up the hierarchy of concept formation. Ofcourse one concept acts as the formative for the next concept or many other concepts to be build upon and the process continues.

The study has attempted to document the various learning/ pre-requisites for arithmetic at the primary school level.

Prerequisites skills are the skills which are essential to learn a particular concept. In order that the concepts, beginning with the very fundamental concepts required for the 3Rs, it becomes important to not only identity the pre-requisites required but also to understand the process of transaction of individualised and group settings for the young learner. These transactions as well as the process of the construction of knowledge need to be based on the learner's learning style. It also needs to be noted that every learner has a different intelligence skill set, what Howard Gardner has explained as multiple intelligence. The way every brain processes information and constructs it into knowledge also varies from individual to individual. As teachers it becomes important to be able to break the concepts into as minute as possible units and then be able to gain insight as to which connections a particular child has not been able to make. This process of insight into the various minute units which constitute a concept is referred to as task analysis. The process of task analysis facilitates any teaching learning process but it does more for remediation teaching as well as teaching of children with diverse brain structures. These diversities in brain structures need not be considered always as dysfunctioning of brain structures. They may be just alternatives to brain functioning. As the education system does not often accepts alternative brain functioning and alternative ways of assessing and constructing concepts, the education system does not provide platform of the practionerie the school teacher to approach the same concept in a variety of ways in the classroom. Thus it leads to an advantage to learning for some learners and continuously a disadvantage and limitation to other set of learners whose brain processing structures and functions may vary. Such learners often are classified as dysfunctional and may come under the classification of disability rather than diverse learners.

For example in order to be able to learn such a simple thing as alphabet recognition effectively, an individual should be able to do at least the following and more

- Visual scanning
- Visual tracking
- Visual discrimination
- Figure ground perception
- Discrimination between vertical and horizontal and left and right (Laterality)

- Horizontal and vertical lines, slanting lines
- Open-ended and close ended curve
- Visual closure (form constancy)
- Upper and lower case alphabets

While in the case of learning styles the individuals can take in information and process it through a number of different senses but the route of intake and processing is best through a particular sense. Thus the individual learns best when provided opportunities to learn through that particular sense. This sense could be visual, auditory, kinaesthetic or tactile or a different combination of them. This applies for those learners in the classroom who have all their sense organs effective for taking in information from the environment. Next let us look at the learner who is not able to utilise any one or more of the sense organs (person with a 'disability') because the learner does not have those organs functioning affectively because of structural or other physiological organic reasons. There may be a child who is blind or another who has a hearing impairment. Now in an inclusive classroom, the teacher can take out the material from the same Teaching Learning kit which had material developed for different concepts according to the various possible ways of information processing according to different learning styles. For example the TLM which is applicable for a child who is NOT a visual learner will be applicable for a child who is blind, sometimes with a little modification.

Thus whatever may be the reasons and the processes involved, both sets of learners would benefit if the same concepts are learnt through the TLM involving as many different domains as possible.

After an extensive study of the theories which involve processes of information intake by the brain and the subsequent processes of knowledge construction by the individual, the different preferred domains by which individuals gain and construct were identified. These were validated by experts from multidisciplinary fields. These include: visual/ visual spatial, auditory, tactile, bodily kinaesthetic, music, verbal linguistic, written linguistic, logical mathematics, interpersonal, intrapersonal, naturalistic and existentialism.

If one were to be able to form a checklist of all the possible indicators of visual, auditory, kinaesthetic difficulties that a child may face in learning of a particular concept, then Teaching Learning Materials (TLM) can be so developed that it facilitates the learning of those concepts and building upon it the new concepts. The child may be a child with special needs because of limited structural functional presence of a sense organ such as eye, ear, limbs or diversity in the way the brain processes information (SLD, ASD, ADHD so on). There may also be that the child just has a preference for a particular sense to process information over another different learning style.

In the case of organic limitation the child does not have the option to use that sense for information intake and processing or in the case of the child who is blind or hearing impaired

According to Levine's view of the mind, the brain processes information using eight major systems and many subsystems. The major system includes memory, spatial ordering, sequential ordering, language, motor control, attention, social thinking, and higher level thinking.

Human beings take in information through the five senses, namely visual, auditory, tactile, olfactory and each of these has divisions such as visual acuity, depth perception, visual figure ground perception, visual motor perception and so on. An effective teacher needs to be able to identify the area through which the child learns best.

This project attempted to list the various prerequisites that are needed to learn any concept in primary school and also supplement it with the requisite teaching learning material.

Studies highlight that diverse learners often tend to make mistakes with obviously simple and unrelated ideas, such as identifying a line segment as an angle or calling the word, 'scattered', as 'pile'. On closer examination it becomes obvious that these are issues related to reversibility. Similarly some other child may find it very difficult to remember the mathematical tables, which would besides being related to memory also be related to the ability to sequence appropriately.

Hence this study developed a detailed set of possible pre-concepts/ requisites that a learner needs to have learnt in order to go on to the higher level concepts in arithmetic. Each of the major domains stated below have a number of further subdivisions under them. For example even scribbling which is a precursor to effective writing would have scribbling without boundaries, scribbling within boundaries, scribbling horizontally, scribbling vertically and so on. Similarly an extensively detailed sub sets were identified and then validated by experts.

- Scribbling:
  - Understand direction and directional terms :
  - Comparisons:- Early Number Ideas:
  - Lines Formation
  - Basic Shapes :
    - Recognition
    - Differentiation
    - Combining shape
- Number Sense :
  - Conservation
  - Understanding
  - Sequencing
  - Comparison
  - Mathematical Signs
  - Writing numbers
- Arithmetic Reasoning:
  - Number line
  - Place value
  - Basic Addition
  - Basic Subtraction
  - Multiplication
  - Division
  - Decimals
  - Arithmetic Reasoning: (story sums)
  - Errors in transferring from rough to fair work
  - Representation of Sorting by Graphs

Attempts are further being done by this study to compile together all the possible terminologies which are used with reference to the different operations used in arithmetic. Often a child may not be able to perform a particular operation just because he/she does not understand the meaning and is unable to connect it to a particular operation of arithmetic.

### Essential language pre-requisites of arithmetic

- Vocabulary
- Subtraction
- Difference
- Few
- Lesser
- Remainder
- How many Left
- How many More
- Minus
- Add
- Altogether
- Sum
- Plus
- Total
- Vertical
- Horizontal
- Right
- Left
- Take away
- Carried forward
- Borrow
- Decrease

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