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Framework for Pedagogical and Socio-Cultural Analysis of Mathematics Textbook

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Abstract – Mathematics is an essential part of the number of subjects taught formerly from early childhood education to secondary level. Use of proper teaching learning materials is essential in the transaction of the mathematical concepts. Textbooks are largely the main resources in teaching–learning processes in many situations and especially in the remote parts of the country. In mathematical teaching Piagetian constructivism of knowledge focuses on activities of interest while Vygotsky stresses on social construction of knowledge. Hence the TLM-Textbooks should be sensitive to the diverse context from which the learners come and in which they learn. In this article the an attempt to develop a framework for analysis of mathematics–grade -3 textbook-Ganit ka Jadoo, from pedagogical and socio-cultural perspectives. Parameters for analyzing the content presented in the textbook were identified from insights provided by Shulman in his presentation of Pedagogical Content knowledge, where he emphasized on combining content of the subject and the pedagogy involved to present the content to be analyzed from pedagogical perspective. Similarly inputs about socio-cultural perspective by Vygotsky aided in develop an understanding how individuals attain their knowledge from community. In this study an attempt is also made to refer to the learning outcome presented by NCERT and to analyze presentation of the concepts with reference to the parameters and to locate the representation of socio cultural perspective in the text.

Important Words: Pedagogical Perspective, Socio-Cultural Perspective

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INTRODUCTION

Mathematics is defined as 'the abstract science of number, quantity and space' by The Concise Oxford Dictionary (Allen, 1990:732). Baroody (1989) states that in cognitive view, the mathematical learning aids in the development of understanding and thinking strategies. Hence it can be seen as a way of arranging the ideas to develop an understanding of the concept. Donald (2011) describes that children have a need to learn about mathematics to make a sense of the world and they start using mathematics and numeracy from a very young age. The National Curriculum (DfEE, 1999a: 60) states 'Mathematics equips pupils with a uniquely powerful set of tools to understand and change the world. These tools include logical reasoning, problem solving skills and the ability to think in abstract ways'. Lee (2006) reiterates that learning mathematics empowers a child which leads to help develop a control of various aspects of one's lives.

MATHEMATICS LEARNING OF THE YOUNG CHILDREN

Numerous theories provide a perspective to an understanding regarding how children learn mathematics. The constructivist theory propagated by Piaget believes that children construct their own knowledge and understanding through their interactions with environment (in Donaldson, 1978). On the other aspect of social constructivism proposed by Vygotsky emphasizes the need of a 'more knowledgeable other' who can help the child in achieving the knowledge and interaction with the social environment as a basis for acquiring the knowledge (in Atherton,2011).This has been termed as scaffolding by Bruner(1966).Gifford(2008) refers to cumulative learning which implies that learning is to be built on previously learnt ideas. Teaching children something not related to previously learnt ideas would not be effective. Barmby et al.(in Taylor,2013) view this as continuum of learning where there is an additive effect and refinement of previous understanding. This understanding to work of Brunner (1966) who proposed the idea of spiral curriculum where in the child is exposed to an idea in a repeated manner to achieve a better and deeper understanding. Brunner's influence can be seen in the practice of teaching mathematics. He also suggested that children go through three phases of learning, first enactive phase when children learn through concrete objects which can

be manipulated and explored. The second phase is iconic phase wherein children begin to represent ideas in an abstract form. Brunner advocated the use of models and images at this phase.The third and ultimate phase is called the symbolic phase where the children can use abstract ideas and ways of representing mathematics.

Liebeck's (in Taylor,2013) ELPS approach wherein E stands for Experience-practical experience of the mathematical ideas, L for language- need for the children to learn the language of mathematics ,P-for pictoral representation of mathematical ideas and ultimately using symbols, is related to Brunner's phases of learning mathematics.

Gifford (in Taylor,2013) advocates the essence of multisensory approach for learning mathematics.

The above discourse provides an insight as to what kind of activities or content is to be presented to the learners in the teaching of mathematics. The TLM's used as a resource should be equipped with the features outlined for the teaching-learning of mathematics.

SIGNIFICANCE OF TEXTBOOKS AS TLM

Among other educational facilities such as Infrastructural and resources required for facilitating educational advancements, TLM is the one of most important aid to learning. TLM's can be described as resources which the teacher uses during the teaching process and similarly students utilize it as a learning resource for acquiring or revising their knowledge(Apple &Christian-Smith 1991).TLM facilitates learning course in uncomplicated and lasting. In most developing countries, among the TLM's Textbooks are most widely used and thus acquire significant position (Ali et al, 2007)

Textbooks are considered as important means for the realization of the prescribed curricula and hence is extensively accepted as a universal feature of classrooms worldwide. The content presented in the textbooks and their structure promotes the explicit vision of the curriculum. The content of the textbook influences selections and emphasis of the subject matter on both student and teacher as the subject matter has bearing on the learning outcome (Mulryan, 1984). Physical structure of the textbook determines whether the intended audience selects the textbook while structure of knowledge ,vital for learning has been outlined by Valverde et al. (2002); Area and framing, Elements (pictorial, verbal, design), Colour and Non colour, Information levels, Unification and Separation.

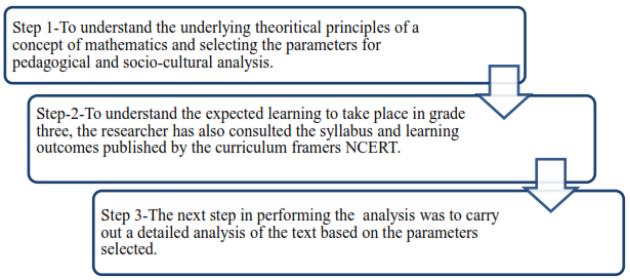
The textbook writers sometimes overlook certain feature which can have an impact on the target audience that ultimately bears an effect on the leaning. Thus it becomes imperative to perform textbook analysis by identifying these features to establish the effectiveness of the textbook. . The CABE report(2005)reiterates that re-examine of textbooks has to be undertaken on the basis of certain identifiable parameters which are clearly spelt out in the educational polices and the Constitution.

METHODOLOGY

This study started with the question whether the textbooks are adequately designed to meet the educational need of the children. The objective of the study was to 'Revisit and analyze TLM of grade 3 mathematics from pedagogical and socio cultural perspectives'.

The study pertains to revisiting of textbook; the researcher selected and attempted to perform the analysis of the class 3 textbook-Ganit ka Jadoo, published by JPEC Jharkhand (2013). The text book is analysed from [i] pedagogical perspectives [ii] Socio cultural perspectives in order to assess whether this text books have followed the theoretical pedagogical principles in general while compiling and have taken into account and contextualised them from socio cultural perspective with respect to the lives of tribes of Jharkhand in particular. An attempt has been made to evolve a framework textbook analysis based on the work of Ali et al (2007).

Procedure adopted for evolving a framework:



The parameters for Pedagogical analysis was selected after developing an understanding of the term" pedagogical content knowledge "as stated by Shulman (1986) which can be understood as to the dimension of subject matter knowledge for teaching that includes forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations – in a word, the ways of representing and formulating the subject that make it comprehensible to others. It represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction. With the understanding of "Pedagogical Content Knowledge" the parameters were identified for pedagogical analysis as illustrated by Ali et al. (2007). The parameters were-Development of the concepts, Opportunities for revisiting (spiral arrangement), Opportunities for hands on activities,

Co-operative learning, Estimation ,_Contextuality, problem solving, reasoning, Element of challenge, Opportunities for children's imagination.

Similarly Socio-cultural approaches emphasize the interdependence of social and individual processes in the co-construction of knowledge. Sociocultural approaches to learning and development were first systematized and applied by L. S. Vygotsky and his collaborators in Russia in the nineteen-twenties and thirties. John-Steiner, 1985 in his work has cited that the thought of a child is largely shaped by the language and visual symbols used by the surrounding people and by socially ordered ways of parenting. Keeping in account of the preceding argument the researcher has selected the parameters- Language, Story based task and Contextuality-attire, festivals, songs, folklores, drawings etc for analysis of the socio-cultural representation in the selected book.

The next step involved the comparison with the content presented in the textbook and the learning outcomes prescribed by NCERT. . The comparison with the prescribed leaning outcomes helped in understanding that the subject matter finds its representation for the particular grade. A detailed analysis of each chapter was undertaken to understand if the theoretical principles of teaching mathematics, the pedagogical principles and socio-cultural aspects are aptly represented in the textbook. To elaborate further on pedagogical and socio-cultural analysis, each page was analysed for the presence or absence of the parameters selected and critiqued. An example of page wise analysis, comparison with theoretical principles of learning measurement and the learning outcomes of Chapter4 on measurement of Length is illustrated in the following table:

Page number and Concept Presented	**Pedagogic and learning outcome prescribed by NCERT**	**Adhering to the theoretical principles of teaching measurement of length**
Page no.46 and 47 – Discussion about traditional methods of measuring	This activity adheres to the prescribed norms to use body parts to measure and understand the non-standard ways of measurement	To learn proper sequence of measurement the children should begin with comparing lengths, using non-standard units, include the use of manipulative standard unit and thereafter using standard unit and incorporate the ruler to measure length in standard units. (Clements, 1999c; Kamii and Clark, 1997**).**
48 and 49- Shift from non-standard methods to standard methods.	Shift from non-standard to Standard method of measurement is observed.	The basis for this sequence is, overtly or absolutely, the theory of measurement of Piaget et al. (1960). The rationale is that this sequential learning motivates children to see the need for a standard measuring unit.
50-51- Estimation is introduced wherein the child is introduced to measuring length of various objects and comparison of the length is seen in this page	Devises ways of making uniform units for measuring length/distances.	Transition from informal to formal measurement needs much more time and care, with instruction in formal measure always returning to basic principles (see Irwin, Vistro-Yu, and Ell, 2004).
52-53- Introduction of meter and centimetre. 54 and 55- Estimation of length of in meters and centimetre.	Appreciating metre as a standard (uniform) unit of length.	
56 and 57- Measurement of distances through problem solving.	Demonstrating ways of measuring smaller distances using a metre scale.	
58 and 59 – exercises on measurement of various objects and distances in standard measurement scale. Poem to present the	Measuring relatively small objects by dividing the meter into centimetre	

length through estimation.		

CONCLUSION:

Mathematics is an essential part of the number of subjects taught formerly from early childhood education to secondary level. In Indian context the textbooks largely the main resources in teaching–learning processes in many situations and especially in the remote parts of the country, perhaps the only learning material available. Use of proper teaching learning materials is essential in the transaction of the mathematical concepts. It is evident that content and structure of the textbook largely influences the teaching and learning of mathematics. Sound amalgamation of content and pedagogy aids in presenting the content in an organized manner so as to cater to the diverse learning abilities and interests of the learners. Socio-cultural representation enables the learners to identify with the context and thus enhances their learning abilities. Education is a good means to promote equity in diverse society. Textbooks should cater to the diverse learning styles and abilities of all children. This feature is sometimes overlooked by textbook writers which do impact the learning of the children. The re-examining of textbooks has to be undertaken on the basis of certain identifiable parameters which are clearly spelt out in the learning of the subject and also in educational polices and the Constitution.

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