

MATHEMATICS EDUCATION FOR THE PRIMARY SCHOOL CHILD

Maximum Marks: 100

External : 70

Internal : 30

Design of the Course

- Each unit of study focuses on the specific aspect of Mathematics education relevant at that stage.
- Several Hands-on activities are part of each unit of study.

Rationale and Aim

When children come to school, they are already familiar with Mathematics and are using it in their own ways. In school they come across a systematic treatment of Mathematics which at times is in conflict with their internalized processes. It is important for teachers to understand these conflicts and differences for effective learning.

In the Position Paper produced by the National Focus Group on Teaching of Mathematics (NCERT, 2006) it was said, "Mathematics education relies very heavily on the preparation that the teacher has, in his/her own understanding of Mathematics, and in his/her bag of pedagogic techniques". Every teacher needs to develop his/her understanding of Mathematics afresh from the point of view that takes in account the processes in which learning takes place in children's mind. Teachers need to be aware of the ways in which students think so that they can design and adapt their teaching approaches to deal with the alternative conceptions of mathematical knowledge of young learners.

The aim of the course is to sensitize prospective teachers that, not only do they need to reflect on their own knowledge of mathematical content taught at the primary level but they also need to connect to children and their experiences. Engagement with this course should enable prospective teachers to learn and reflect on what research has to say about children and their Mathematics education and use it to promote learning.

Specific Objectives

To help student-teachers:

- reflect on what is mathematics, by actually "doing" mathematics - spotting and exploring patterns in a calendar, a multiplication table and other such number matrices
- reflect on why we need to learn mathematics
- reflect on the fact that mathematics is a subject that everyone can do and enjoy

- develop deeper insights into the content areas of mathematics at the primary level
- become aware of factors that impact on the process of acquisition of mathematical knowledge
- acquire sensitive student-teachers about the ways in which children respond to mathematical knowledge
- become aware of the historical roots of the subject, and of great problems that mathematicians have grappled with in past centuries, which have served as guide posts in the development of the subject: to make student-teachers aware of the fact that mathematics is a human endeavour
- become aware of the exploratory nature of the subject, and the fact that mathematics is "work in progress" and not a "finished product"
- gain awareness of the aesthetic and fun side of mathematics, and its rootedness in pattern, rhythm and play, through exposure to mosaic, rangoli, kolam, number games and puzzles
- gain facility in hand-on activities such as paper folding and model making
- develop skills, have deeper insights, acquire appropriate attitudes, learn effective strategies that promote effective children's learning

UNITS OF STUDY

UNIT 1: Pedagogical Content Knowledge

- Numbers: Number Concept, Counting, Place value, Arithmetic operations, Fractions, Decimals, using paper folding to show operations on fractions
- Space and Shape: Geometric shapes, construction of geometric shapes through paper folding, Symmetry, Polyhedra, Tessellations, Mosaic, (optional - *rangoli, kolam*)
- Measurement: The idea of unit, length, area, volume, weight, time, money, temperature
- Data Handling: Sorting, Classification, Tabling, Reading information from simple graphs

UNIT 2: Perspective about Mathematical Knowledge

- Aspects of mathematical knowledge: Conceptual and Procedural
- Vergnaud's framework for acquisition of concepts with respect to mathematical knowledge

UNIT 3: Children's Conceptualisation of Mathematics

- Theories of mathematics learning: Piaget, Dienes, Skemp
- Role of language of communication in a Mathematics classroom
- Effect of socio-cultural background of children on mathematical knowledge

UNIT 4: Aspects of Teaching Mathematics

- Methods of teaching Mathematics
- Beliefs about teaching-learning processes
- Planning for teaching: Annual plan, Unit plan, Lesson plan
- Hidden curriculum: Social justice, gender differences, individual differences, Inclusive environment

UNIT 5: Assessment

- Purpose of assessment
- Planning assessment
- Assessment tools
- Evaluation of performance

Mode of Transaction

- Prospective teachers to be engaged in discussions on observed children's work in order to acquire an understanding on how children respond to mathematical knowledge.
- Prospective Teachers in groups develop concept maps to understand linkages and relationships between various mathematical concepts and to imbibe the importance of team work.
- Reading of texts (suggested as discussion) with dialogue to understand theory from the point of view of issues raised.
- Collecting historical samples of mathematical knowledge (such as ways to multiply in different cultures) and reflecting on them.
- Performing simple mathematical experiments and investigations, with numbers or geometric shapes.
- Preparing mathematical models, particularly geometric - paper folding, straw or string models of polyhedra, tessellations, etc.
- Critically examining teaching-learning materials through presentations.

Essential Readings

1. Haylock, D. (2006) *Mathematics Explained for Primary teachers*. Sage : New Delhi, Ch 22: Measurement pp 247-263.
2. Lieback, P. (1984). *How children learn mathematics: a guide for parents and teachers*. Penguin: London.
3. Olson, T. A. *Mathematics Through Paper Folding*, Arvind Gupta's toys book Gallery.
<http://gyanpedia.in/tft/Resources/books/paperfolding.pdf>
4. Post, Thomas, R. (1992) *Teaching Mathematics in Grades K-8, Research-Based Methods*. California: Allyn and Bacon, Chapters 1, 4, 5, & 6.
5. Skemp, Richard R. (1989) *Mathematics in the Primary School*. Roulledge:

- London Chapter 3: The formation of Mathematical Concepts. pp 49-71 Chapter 4: The Construction of Mathematical Knowledge. pp 72-89 Chapter 5: Understanding Mathematical Symbolism. 90-108.
6. Srinivasan P K *Romping in Numberland*. National Book Trust: New Delhi. <http://gyanpedia.in/tft/Resouces/books/rompinginnumberlandeng.pdf>
 7. Srinivasan P K *Number Fun With a Calendar*. Arvind Gupta's toys book Gallery. <http://gyanpedia.in/tft/Resouces/books/calender.pdf>
 8. Srinivasan P. K. *Math Club Activities*. Arvind Gupta's toys book Gallery <http://gyanpedia.in/tft/Resouces/books/pkshindu.pdf>.
 9. Zevenbergen, R., et al. (2005). *Teaching Mathematics in Primary Schools*. Allen & Unwin: Australia (First South Asian Edition). Chapter 2, 3, 7 and 9.

Readings for Discussion

1. Carraber, T. N., et al. (1988) Mathematical concepts in everyday life. In G. B. Saxe & M. Gearhart (ed) *Children's mathematics. New Directions for Child Development*. Jossey-Bass: San Francisco. pp 71-87.
2. IGNOU. AMT - 01 *Teaching of Primary School Mathematics*. IGNOU: New Delhi.
3. IGNOU. LMT - 01, *Learning Mathematics*. IGNOU: New Delhi.
4. NCERT (2005) NCF 2005 *Position Paper on Mathematics* NCERT: New Delhi
5. Paul Lockhart. *Lockhart's Lament*
<http://www.maa.org/devlin/LockhartsLament.pdf>
6. Skemp, R. (1978) Relational understanding and instrumental understanding. *Arithmetic Teacher*, 9-15
7. Wood: David. (1998). The Mathematical Mind. In *How Children Think and Learn*. Blackwell Publishing: UK. Chapter 8. pp 225-255.

Advanced Readings

1. Ball, D. Let. al. (2008). Content Knowledge for Teaching: What Makes It Special? *Journal of Teacher Education*, 59(5),
2. Briggs, M. and Davis, S. (2007). *Creative Teaching: Mathematics in the early years and primary classroom*. Routledge: UK. pp 89-407.
3. Douglas, H. Clements, Julie, S. (2009). *Learning and Teaching Early Math: The Learning Trajectories Approach* Routledge: UK
4. Nunes, T. and P. Bryant. (ed) (1996). *Children doing mathematics*. Blackwell : UK
5. Orton A. (2004). *Learning Mathematics, issues, theory and classroom practice*. Continuum: London. pp. 1-26, 156-174, 175-193.
6. Richard R.S. (2002) *Understanding mathematical symbolism in Mathematics In Primary Schools*. Routledge: UK.