Master of Education (M.Ed.)

Title of the Course: S. Ma.1(a) Introduction to Mathematical Thinking
(Semester: I, II, III & IV)

Credits: 4
MM: 100 (External: 70 Internal: 30)
Contact Week 15

Introduction of the Course

This course has been designed for students who wish to understand the nuances of development of mathematics as a disciple. The course delineates main assumptions behind a range of theoretical perspectives on the nature of mathematics. The course engages in conceptualising and analysing the processes that promote learning of mathematics from a disciplinary perspective. Issues and related to nature of language of mathematics and how linguistics affect learning of mathematics will dealt with through seminal scholarly texts and researches. Scholars will also study contemporary researches in Mathematics education and teacher development.

Learning Outcomes

1. After completion of the course student will be able to: (Number is not fixed)
2. Comprehend how mathematics is a humanly created subject
3. Promote analytical thinking and how it leads to creating mathematical structures
4. Build a disciplinary perspective of mathematics
5. State the aspects and perspectives of cultivating reasoning and communication; problem solving and problem posing
6. Associate with teacher's beliefs and knowledge about Mathematics education
7. Conduct mini researches in the area.

Number of Units (4) **Weeks 15 = 60 hours**

Unit 1: Essence of Doing Mathematics **(4 weeks = 16 hours)**

- Mathematics as a study of patterns of shapes, chance, numbers, motion, variation.
- Thinking mathematically: Building logical thinking, analytical thinking and quantitative reasoning.
- Axioms, origin and significance of axioms; Understanding how axiomatic systems form the basis of creating mathematical structures.
- Proof and proving: Nature of proofs, Methods of proving.

Unit 2: Learning Mathematics **(3 weeks = 12 hours)**

- Problem-solving and Problem-posing
- Mathematical modelling

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Unit 3: Research in Mathematics Education **(4 weeks = 16 hours)**

- Contemporary and emergent issues in mathematics education.
- History, issues and current trends pertaining to design and methodologies.
- Research in policy making, teaching, student-learning in mathematics.

Unit 4: Teacher's knowledge and beliefs **(4 weeks = 16 hours)**

- Teachers' knowledge and belief about the disciple of mathematics
- Reflective teaching practices in mathematics
- Nature of professional development of a mathematics teacher.
- Challenges and scope for continuing professional development of teachers.

Practicum/ Suggested Projects / Assignments (Any Two)

1. Observe and document the developmental patterns in children with reference to development of reasoning skills
2. Observe a couple of classrooms of at least two teachers of mathematics. Document the pedagogic decisions that they take while teaching mathematics.
3. Pick any research design of mathematics education. Devise a research proposal using the design.
4. Engage in self-reflection and document the role of family, teachers and textbooks in development of mathematical identity among the students.
5. Interview five children and explore the challenges, issues and concerns with regard to studying mathematics in school.

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Essential/ Recommended Readings

- Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? Journal of Teacher Education, 59(5), 389–407.
- Bauersfeld, H. (1988). Interaction, construction, and knowledge: alternative perspectives for mathematics education. In D.A. Grouws, T.J. Cooney & D. Jones (Eds.), Perspectives on research on effective mathematics teaching (pp. 27 - 46). Reston, VA: National Council of Teachers of Mathematics.
- D'Ambrosio, U. (1990). The role of mathematics education in building a democratic and just society. For the Learning of Mathematics, 10, 20–23.

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- Ellis, M., & Berry, R. Q. (2005). The paradigm shift in mathematics education: Explanations and implications of reforming conceptions of teaching and learning. The Mathematics Educator, 15(1)
- Gandhi, H. (2018). kya ek "Achchi Kaksha", "Ganit ki Safak Kaksha" bhi kahi jaa sakti hai? Pathshala. Bheetar aur Bahar. Azim Premji Publication. 1(1).
- Gandhi, H.(2020). Developing Acquaintance with Mathematics Dispositions via language. Language and Language Teaching. 8(2). pp 8-12.
- Gandhi, H. (2013). Professional Development Programmes: Voices of Teachers. Conflux, Journal of Education. NAS publishers. Kerala. India. 1(3). 15-18.
- Gandhi, H. (2018). Searching for Didactical negotiations in Mathematics textbooks Voices of Teachers and Teacher Educators. NCERT on behalf of MHRD. VI(II). 50-57
- Gandhi, H.(2016). What Mathematics matters to teachers? Voices of Teachers and Teacher Educators. NCERT on behalf of MHRD. 5(1). 26-31.
- Gutstein, E. (2007). "So one question leads to another": Using mathematics to develop a pedagogy of questioning. In N. S. Nasir & P. Cobb (Eds.), Improving access to mathematics: Diversity and equity in the classroom (pp. 51-68). New York
- Hanna, G. (1995). Challenges to the importance of proof. For the Learning of Mathematics, 15(3), 42-49.
- Hill, H. C., Sleep, L., Lewis, J. M., & Ball, D. L. (2007). Assessing teachers' mathematical knowledge: international perspective. Mahwah, NJ: Erlbaum.
- Kazemi, E., & Stipek, D. (2001). Promoting conceptual thinking in four mathematics classrooms. The Elementary School Journal, 102(1), 59–80.
- Lubienki, S. L. (2000). Problem solving as a means toward mathematics for all: An exploratory look through a class lens. Journal for Mathematical Behavior, 15(4), 375-402.
- MESE -001(2003). Teaching and Learning Mathematics. IGNOU series
- Moschkovich J.H. (2010). Language and Mathematics Education: Multiple Perspectives and Directions for Research. Learning of Mathematics, 17(3), 17–23.
- Mukhopadhyay, S., & Greer, B. (2001) Modeling with a purpose: Mathematics as a critical tool. In B. Atweh, H. Forgasz, & B. Nebres (Eds.), Sociocultural research on mathematics education: An international perspective (pp. 295–311).

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- Philipp, R. A., Ambrose, R., Lamb, L L. C., Sowder, J. T., Schnappelle, B. P., Sowder, L., Thanheiser, E., & Chauvot, J. (2007). Effects of early field experiences on the mathematical content knowledge and beliefs of prospective elementary school teachers: What knowledge matters and what evidence counts? In F. K. Lester (Ed.), Second handbook of research on mathematics teaching and learning (pp. 111–155). Charlotte, NC: Information Age.
- Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. Review of Educational Research, 75, 211-246.

Additional Readings

- Atweh, H. Forgasz, & B. Nebres (Eds.), Sociocultural research on mathematics education: An international perspective (pp. 295–311). Mahwah, NJ: Erlbaum.
- Barta, J., & Brenner, M. E. (2009). Seeing with many eyes: Connections between anthropology and mathematics. In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.), Culturally responsive mathematics education (pp. 85–109). New York: Routledge.
- Bharath. S., English, L. (2010).Theories in Mathematics education. Seeking new frontiers. Springer.
- Cobb, P., & Hodge, L. L. (2007). Culture, identity and equity in the mathematics classroom. In N.S. Nasir & P. Cobb (Eds.), Improving access to mathematics: Diversity and equity in the classroom (pp. 159-171). New York: Teachers College Press Dowling, P. (1998). The sociology of mathematics education: Pedagogic texts. Bristol, PA: Falmer Press.
- Ernest P. (1991). The Philosophy of Mathematics Education. Gay, G. (2009). Preparing culturally responsive mathematics teachers. In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.), Culturally responsive mathematics education (pp. 189–205). New York: Routledge.
- Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in U. S. schools. Educational Researcher, 35, 3–12.
- Lakatos, I. (1976). Proof and Refutations: The Logic of Mathematical Discovery, ed. J. Worrall and E. Zahar. Cambridge: Cambridge

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- Moschkovich, J. (2007). Bilingual mathematics learners: How views of language, bilingual learners, and mathematical communication affect instruction. In N. S. Nasir & P. Cobb (Eds.), Improving access to mathematics: Diversity and equity in the classroom
- Mahwah, NJ: Erlbaum. Newman, J. (2003). The World of Mathematics: A Four-Volume Series. Washington Tempus
- Noss, R. & Hoyles, C. (1996). Windows on Mathematical Meanings. Dordrecht: Kluwer Academic Publishers.
- Schoenfeld, A. H. (2004). The Math Wars. Educational Policy, 18(1), 253.
- Skemp, R. (1978). Relational understanding and instrumental understanding. Arithmetic Teacher 26 (3), 1-16.
- Timothy Gowers (2002). Mathematics: A Very Short Introduction. Oxford University Press
- Wheeler D (1983). Mathematisation matters. For the Learning of Mathematics, 3(1).
- Stanic, G. M. A. (1989). Social inequality, cultural discontinuity, and equity in school mathematics. Peabody Journal of Education, 66(2), 57-71. Borba, M., & Skovsmose, O. (1997). The ideology of certainty in mathematics education. For the Learning of Mathematics, 17(3), 17–23.
- Bristol, PA: Falmer Press. Burton, L. (2003). Which Way Social Justice in Mathematics education? Westport, CT: Praeger Publishers.
- Devlin K. (2011). Introduction to Mathematical thinking.

Teaching Learning Resources (Digital and others): Across Units (If any)

- https://www.youcubed.org/
- https://mathvalues.squarespace.com/masterblog/category/Devlin%27s+Angle
- https://www.ox.ac.uk/news-and-events/find-an-expert/professor-marcus-du-sautoy

Teaching Learning Process

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

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Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end-semester examination.

Key words: Essence of Mathematics, Learning Mathematics, Research in Maths Education.

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