

Tribhuvan University
Institute of Science & Technology

Course Title: Teaching Methodology (Elective)
Course No.: Math 405
Level : B. Sc.
Nature of course: Theory and practical

Full Marks: 100(75 Theory+ 25 practical)
Pass Marks: 35(26.25 Theory + 8.75 Practical)
Year: IV
Period per Week: 9 hrs.

Introduction

What we teach and how we teach mathematics are inextricably linked and very much dependent on one another. Even though both are tightly linked, they are still separate. Growth of content knowledge doesn't automatically improve teaching efficiency. The present course supports questioning about teaching and learning mathematics. This course provides an introduction to teaching mathematics in schools. It introduces effective teaching of mathematics combining an understanding of how children learn, how to promote that learning by teaching through problem solving, and how to plan for and assess that learning on a daily basis. Thus, this course is designed to help students develop pedagogical strategies for teaching in the future.

Learning outcomes

At the end of this chapter the student will be able to:

- Recall various theories of learning
- Make links between these theories and the teaching of mathematics
- Appreciate the importance of teaching the skills and concepts in math as well as problem solving.
- Appreciate the importance of the teacher-pupil relationship
- Choose the most appropriate teaching strategy for the classes
- Design the most appropriate unit lesson plan for a particular topic
- Ensure the key issues of good classroom management
- Use intrusive strategies to control the class.
- Appreciate the role of practical work in school maths;
- Discuss the pedagogical approaches used for teaching school math.
- Plan for and understand the needs of gifted students in your class
- Promote learning by teaching through problem solving
- Discuss strengths and weaknesses of different contexts
- Describe a variety of ICT resources suitable for use in the math classroom
- Discuss factors which influence the decision on the type of ICT being used

Examination:

There will be a final examination of the theory part of 75 marks for the period of three hours. However practical part of 25 marks will be conducted by the concerned Department of Mathematics and the marks will be submitted to office of the controller of examination. The candidate must pass in theory and Practical part separately.

Course Contents in detail:

Unit 1: Teaching for Understanding: Mathematical Knowledge or Enquiry: 20 Lectures

Theories of how children learn: Skinner, Piaget, Vygotsky, Blooms Taxonomy, Polya heuristic
Perspectives on teaching: Dutch RME, Reggio Emilia, Rogoff.
Twofold nature of math: The folk pedagogies in teaching, Gardners unschooled mind, Types of learners.
Mathematics as a mode of enquiry: Active engagement in mathematics, Modern learning theory,
Metacognition
Mathematics as a body of knowledge.

Unit 2: Being an Effective Mathematics Teacher: 10 Lectures

Requirements for an effective teacher of mathematics: thorough knowledge and classroom experience, skill of exposition or telling Connectionist orientation:

- making connections between the pupils prior knowledge and new concepts or skills;
- connecting the pupils informal intuitive knowledge with formal mathematics;
- connecting the various representations of maths: concrete activities, mathematical language and symbol systems;
- connecting areas of maths such as addition and subtraction (inverses), linking fractions, decimals, percentages and proportion as different ways of writing the same entity.

Effective lesson planning and its pedagogical analysis: Effectiveness in terms of a lesson:

- a clearly thought out plan for the lesson;
- well-structured delivery and pace;
- a variety of activities to achieve the intended learning outcomes or key objectives;
- informative review and reaction.

A pedagogical analysis: aims and learning outcomes.

Discuss exemplars/non-exemplars and criterial attributes

Discuss Stones heuristic for teaching subject knowledge: relate Stones heuristic for teaching maths as a body of knowledge and a mode of enquiry to the strategic structure for Mathematics. Planning problem-solving, Teaching skills embedded in the heuristics

Establishing a positive learning environment Organising the maths classroom, The role of the teacher throughout the academic year, Previous experiences of maths

Dealing with underachievement in math:

Gender issues in math: Available resources for teaching mathematics

Unit 3: Classroom Management and Working with Pupils: 15 Lectures

Teacher-pupil relationship and its importance, The teachers authority, Rapport and respect Teaching strategies: Whole-class teaching, Drill and practice tasks, Individualised programme of work, Experiential learning, Small group work, Investigational work

Discipline and behavior management, Flowing lesson, Maintaining a continuous signal, Importance of advance preparation, Sequence of a lesson, Use of the tactical ignore, The continuum from least- to most-intrusive strategies for classroom control, Positive and negative language, Congruence of tone and gesture, Privately understood signals, Pause, direction, Distraction and diversion, Partial agreement, When then directions, Choice direction, Question and feedback, Rule reminders, Cool-off time

Structure for dealing with disruptive pupils

Unit 4: Designing an Effective Lesson Plan: 20 Lectures

Components of a Lesson Plan:

(a) Prior skills inventory (preassessment).

- (b) The aim of the lesson, or its purpose.
- (c) A start-up activity.
- (d) A motivational activity.
- (e) The body of the lesson (discovery, developmental, application of new concepts, pivotal questions, etc.).
- (f) The planning of differentiated instructional paths for the gifted, average, and weaker students.
- (g) The generalizations and conclusions (to be modified, if necessary, based on the progress of the lesson).
- (h) The homework assignment.
- (i) If time permits . . . (a brief interesting activity, if there is time left after you have completed your lesson).

Planning Paths of Differentiated Instruction, Planning Group Work in the Math Classroom, Teacher-Centered Versus Student-Centered Instructional Models, The Developmental Lesson Model, The workshop model

Solving Systems of Equations Using the Developmental Lesson Model and the Workshop Model, Designing the Homework Assignment, The elements of the homework assignment that make it effective Routines for Checking Homework: Review of the Previous Days Homework, Planning for Students Who Are Absent

Importance of Planning Board Work: Dealing with the Alternative Solutions, Incorporating Technology into Your Lessons

Planning a Series of Lessons (Unit Planning).

Unit 5: Some Specific Ideas for Teaching Certain Lessons:

15 Lectures

Angle Measurement with a Circle by Moving the Circle, Sum of an Arithmetic Progression, Introducing the Product of Two Negatives, Rationalizing the Denominator, Pythagorean Theorem, Introduction to Non positive Exponents, Introducing the Notion of a Function, Intuition Versus Justification, Art of Classroom Questioning: reasons for asking questions in the mathematics class, Learning to ask good questions, Some Dos and Don'ts of Questioning.

Unit 6: Teaching Number Sense, Algebra and Geometry:

15 Lectures

Reasoning and sense making: What does it mean to promote reasoning and sense making in the mathematics classroom? Current philosophy of how the mathematics topical areas of number sense are to be included in the school curriculum. What does it mean to develop number sense and what are the key mathematical ideas in the high school and middle grades? Teaching of number sense, Sample lesson plan: number sense, Number sense activities sampler, Teaching of algebra, Current philosophy of how the mathematics topical areas of algebra are to be included in the school curriculum. major components of the study of algebra. Sample lesson plan: algebra, Algebra activities sampler, Teaching of geometry, How has the research of the van Hiele influenced the teaching of geometry? Identify the areas of study that are included in the geometry content area. Sample lesson plan: Geometry, Geometry activities sampler

Unit 7: Strategies for Understanding Problem Solving:

20 Lectures

Problem-Solving: Overview, Difficulty Factors, Teaching the process, Strategies for Problem Solving: Drawing a Diagram, Using Concrete Materials, Creating a Table, Looking for a Pattern, Guessing and Checking, Creating an Organized List, Working Backwards, Creating a Tree Diagram, Using Simpler Numbers, Using Logical Reasoning, Analyzing and Investigating Solving Open-Ended Problems

Unit 8: Mathematics in Context:

10 Lectures

Why do people do mathematics? Skills for learning mathematics in context, concepts in order to deepen and broaden their knowledge, Skills and understanding of mathematics essential skills and processes in mathematics that pupils need to learn to make progress

Habits of mind (according to Cuoco and others) that research mathematicians use in creating and using mathematics outside school Strengths and weaknesses of different contexts, Problems with choosing contexts, Cons and contexts Problems with using contexts in teaching, Resourcing and managing good contexts Teaching mathematics in context, meaning of working collaboratively, Asking questions, Keeping going when it is difficult, Justifying reasoning, Motivation for working in this way,

Unit 9: Responsibility of Assessment: 15 Lectures

Evaluative Assessment, Diagnostic Assessment, Designing the Classroom Test: Overriding principles that should govern the administration and grading of an exam, The Scoring Rubric (evaluation scheme), Selecting and the Ordering of Questions, Timing the Test, Preparing Your Students for the Test Informing Students of Their Grades, Improving Their Test Scores, Assessing the Assessment, Remedy of Poor Class performance, Testing Students of Varying Ability Levels, Handling Absentees on Test Days, Comprehensive Assessment: Informal Observations, Portfolios, Notebooks, Journals

Unit 10: The Role of ICT in the Mathematics Classroom: 10 Lectures

Forms of educational technology: describe a variety of ICT resources suitable for use in the maths classroom

Deciding to use ICT (Information and communication technology), Logistics of using ICT in mathematics, Expected outcomes from ICT training in mathematics for different grades. Areas for, and examples of, the incorporation of ICT in secondary mathematics lessons, Enhancing the teaching of mathematics using ICT: Learning from feedback, Seeing connections, Observing patterns in modeling, Exploring data, Teaching the computer, Observing patterns in numbers, Going beyond the norm, ICT for organisation,

Practical works:

1. Planning Paths of Differentiated Instruction (e.g. see p 51 [2])
2. Instructional Models: The Developmental Lesson Model, The Workshop Model (e.g. see p53 [2])
3. Designing the Homework Assignment (e.g. see p 60 [2])
4. Planning Your Board Work (e.g. see p 65 [2])
5. Planning a Series of Lessons (Unit Planning) (e.g. see p 69 [2])
6. Some Specific Ideas for Teaching Certain Lessons (e.g. see p 76 [2])
7. Lesson plans for teaching number sense, algebra, geometry (e.g. see chapters 8 and 9 [3]).
8. Finding alternative solutions of a problem
9. Drawing diagrams for explaining the problems, solutions
10. Use diagrams for justification a mathematical statement
11. Preparing various teaching materials (e.g. using paper or other easily available materials)
12. Designing the Classroom Test: The Scoring Rubric (evaluation scheme) (e.g. see p 157 [2])

Recommended Books:

1. Pamela Cowan, Teaching Mathematics a Handbook for Primary and Secondary School Teachers, Routledge, 2006 (for units 1, 2, 3, 10)
2. Alfred S. Posamentier and et al., Exemplary practices for secondary math teachers Association for Supervision and Curriculum Development, USA 2007 (for units 4, 5, 9)
3. D. J. Brahier, Teaching secondary and middle school mathematics, Pearson 2013 (for units 6)

4. Deborah V. Mink, Ph. D. Strategies for Teaching Mathematics Shell Education Publishing Inc. 2010 (for units 7)
5. Sue Johnston-Wilder and et al., Learning to Teach Mathematics in the Secondary School: a companion to school experience, Routledge, 2011 (for unit 8)

References:

1. C. Kyriacou, Essential Teaching Skills, Nelson Thornes Ltd, 2007
2. C. Kyriacou, Effective Teaching in Schools Theory and practice, Nelson Thornes Ltd, 2009
3. Anthony Haynes, The Complete Guide to Lesson Planning and Preparation, Continuum International Publishing Group, 2010
4. Rosamund Sutherland, Teaching for Learning Mathematics, Open University Press, McGraw-Hill, 2007
5. Polya, G., How to solve it, Princeton, 1973.
6. L. Fazio and R. Siegler, Teaching fractions, IAE Educational Practices Series 2011

Guidelines for setting a question paper

- The question paper will consist of two groups A and B.
- The group A will contain 5 (five) questions, each carrying 10 (ten) marks.
- The group B will contain 5 (five) questions, each carrying 5 (five) marks.
- In each group, there will be two of five questions with OR-question from the same unit.

On the basis of the guidelines mentioned, we enclose one set of model question for Teaching Methodology (Math 405)(elective)

MODEL QUESTION
Tribhuvan University

Bachelor Level / IV year/ Sc. & Tech.

Full Marks: 75

Teaching methodology (Math 405)(Elective)

Time: 3 Hours

Attempt ALL the questions

Group A [5× 10 = 50]

1. Discuss the characteristics of an effective teacher. [10]
OR
What are the five steps inherent in all lessons where new concepts or principles are being uncovered either through direct teaching or discovery via problem-solving? Discuss each step. [10]

2. What are the Components of a Lesson Plan? Discuss planning paths of differentiated instruction. [4+6]
OR
Discuss solving Systems of Equations Using the Developmental Lesson Model. [10]

3. What does it mean to promote 'reasoning and sense making' in the mathematics classroom? Write down the tips for teachers that can be considered in the lesson planning and teaching processes to promote healthy reasoning habits in their students. [3+7]

4. Why do people do mathematics? What are the concepts students need to understand in order to deepen and broaden their knowledge, skills and understanding of mathematics? [2+8]

5. Discuss the role of ICT in the mathematics classroom by asking what questions can a teacher distinguish between occasions when the use of ICT is suitable and unsuitable for the purpose? [10]
Group B [5 × 5 = 25]

6. Describe Skinner's approach to education. [5]
OR
What is Vygotsky's view on how students' mental development can be achieved? Explain it.
What is the zone of proximal development? Which activities in mathematics may help students on making the transition across their current zone of proximal development and into a higher one? [1+1+3]

7. How to maintain a continuous signal in the class room? [5]

8. Show that an alternative method to envision a topic or concept different from the textbook method might be effective by describing young Gauss' method of finding the sum $1 + 2 + \dots + 100$ and using it to derive the formula for finding the sum of the first n terms of an A.P. [3+2]
OR
What is an open ended question in a class room environment? Why do we use open ended questions? [2+3]

9. Make a list of Problem-Solving Difficulty Factors. One of the difficulty factor is 'Wrong Order'. Give an example to explain it. [4+1]

10. What does a 'scoring rubric' mean? Write down a scoring rubric for the following problem: The measure of the exterior angle at the base of an isosceles triangle is 130^0 . Find the measure of the vertex angle of this triangle. (Show all work 15 points.) [1+4]