

B.Ed.Hons. 2.5 Secondary

Teaching of Mathematics (Pedagogy) (Semester 5)

No. of weeks

16

Credit value

3 credits

Prerequisites

Mathematics I (*Semester 2*), Mathematics II (*Semester 3*) and Mathematics III (*Semester 4*)

Course description

The course will focus initially on the processes of learning and teaching mathematics, and then consider the role of the teacher in enhancing learning. Student Teachers will review pedagogical approaches to mathematics and consider priorities for the future in learning and teaching mathematics. It will help them learn from their cultural context and link school mathematics with out-of-school mathematics. Theoretical approaches to learning mathematics will be examined and applied to better understand the key problems and challenges in mathematics education today, which include language issues, technology, contexts, feelings, beliefs, and attitudes. This course will provide Student Teachers with ICT knowledge, and they will look at ways in which ICT can successfully be applied to and integrated into the curriculum. It will help Student Teachers develop cognitive ability (reasoning, decision-making, and reflection) that may be useful to enhance the critical mathematical thinking of students in the context of practice. This course will also assist Student Teachers to develop low-cost resources individually and socially.

Course outcomes

As a result of participation in this course, Student Teachers will be able to:

- acquire a deeper understanding of the ways in which learners learn and teachers teach mathematics, and of connections between learning and teaching mathematics;
- develop skills of reading literature on mathematics education critically and of expressing arguments in mathematics education cogently;
- challenge the beliefs, ideas, and perceptions about teaching and learning mathematics; and,
- appraise theoretical approaches to learning and teaching mathematics and test these ideas in planning for teaching.

Learning and teaching approaches

The following approaches will be used in the course:

- Activity-based teaching
- Inquiry method
- Discovery method
- Exploration method
- Demonstration method
- Lecture method

- Discussion with peers and Instructor
- Use of ICTs to facilitate learning and teaching

Also refer to the link available on the HEC website:

[http://www.hec.gov.pk/InsideHEC/Divisions/LearningInnovation/Documents/Learning%20Portal/NAHE%20\(Presentation\)/COMMON%20TEACHING%20METHODS.pdf](http://www.hec.gov.pk/InsideHEC/Divisions/LearningInnovation/Documents/Learning%20Portal/NAHE%20(Presentation)/COMMON%20TEACHING%20METHODS.pdf)

The site provides a PowerPoint presentation on the above-mentioned methods of teaching, listing their strengths and weaknesses. This will help Student Teachers explore the advantages and disadvantages of teaching methods and take informed decisions on selecting appropriate teaching methods, considering the content and concept of teaching, the learning environment, and the resources available for teaching.

Semester Outline

Unit 1: The nature of mathematics and mathematical thinking

- Different views and perspectives on mathematics and its teaching and learning (e.g. constructivist, humanistic, social constructivist, absolutist, and fallibilist)
- Teachers' conceptions of the nature of mathematics
- Beliefs that influence classroom practices
- Historical development in mathematics: Patterns and relationships

Unit 2: The mathematical processes

- How children learn mathematics
- Understanding mathematical processes (critical thinking and abstract-concrete thinking)
- Methods of teaching mathematics
- Communication in the mathematics classroom
- Connections (establishing relationships among ideas and facts)
- Representation: Abstraction and symbolic representation

Unit 3: Planning teaching and sequencing mathematical content and concepts

- Fundamentals of mathematical content sequencing
- Aligning mathematical content with other subjects
- Managing the mathematics classroom
- Bridging the gap between theory and practice
- Contextualizing content and tasks
- Managing resources
- Adopting or adapting research-informed strategies
- Developing unit plans, lesson plans, activities, and tasks: Enhancing critical-thinking skills
- Research-based decision-making
- Digital tools for learning mathematics

Unit 1: The nature of mathematics and mathematical thinking (3 weeks)

Description

In this unit, Student Teachers will explore the nature of mathematics and the beliefs, perspectives, and conceptions people have about it. These beliefs, perspectives, and conceptions are discussed in the context of the work of great philosophers and mathematicians. An

understanding of different conceptions of mathematics is important to the development and successful implementation of mathematics education. It can be helpful for mathematics teachers to know how the field of mathematics has evolved and the interrelationships of different content areas. Student Teachers will be able to understand the power of mathematics, and the ways our society understands and reacts to the ever-widening influence of mathematics on our daily lives.

Unit outcomes

This unit will enable Student Teachers to:

- explore different views and perspectives on mathematics and its teaching and learning, such as constructivist, humanistic, social constructivist, absolutist, and fallibilist;
- identify possible connections between and the influences of the nature of mathematics upon mathematics teaching and learning;
- acquire the necessary mathematical concepts and skills for everyday life and for continuous learning in mathematics and related disciplines;
- develop the necessary process skills for the acquisition and application of mathematical concepts and skills;
- develop mathematical thinking and problem-solving skills and apply these skills to formulate and solve problems; and,
- develop the ability to reason logically, communicate mathematically, and learn cooperatively and independently.

Week 1

Different views and perspectives on mathematics and its teaching and learning

- Absolutist and fallibilist
- Humanistic, constructivist, and social constructivist
- Instrumentalist and Platonic view of mathematics
- Historical development in mathematics: Patterns and relationships
 - How has mathematics evolved?
 - Is mathematics discovered or invented?

Weeks 2 and 3

- Teachers' conceptions about the nature of mathematics
- Beliefs that influence classroom practice
- Challenging teachers' beliefs about mathematics
- Exploring mathematics concepts, rules, and formulae to learn for conceptual understanding

Unit 2: Mathematical processes (7 weeks)

Description

This unit will consider some of the processes that seem to apply to mathematical challenges, and ask whether what is involved in general problem-solving applies to mathematics.

What is the mechanism by which teachers are supposed to base their teaching on research? And what actually happens in practice when teachers use research in their teaching?

This unit considers the problem and what might be done to create links between settings and linguistic and attitudinal factors that underlie learning difficulties in mathematics, together with ways in which the teacher might improve matters and norms. Furthermore, an array of the most common student misconceptions will be examined. Ways to facilitate students' learning of mathematics for conceptual understanding will be discussed.

Unit outcomes

This unit will enable Student Teachers to:

- understand different mathematical processes;
- identify and practice different problem-solving and logical-reasoning techniques;
- draw upon their knowledge of the concepts and skills they have learned in the earlier courses to be successful problem solvers;
- discuss ways to handle communication in the mathematics classroom;
- make effective use of a variety of mathematical tools (including ICT tools) in the learning and application of mathematics;
- recognize and use connections between mathematical ideas and between mathematics and other disciplines;
- develop positive attitudes towards mathematics;
- produce imaginative and creative work arising from mathematical ideas; and,
- build up mathematical terminology.

Weeks 4 and 5

How children learn mathematics

- Insights Student Teachers must have in order to understand basic mathematical concepts
- Understanding mathematical processes
- Concept formation
- Critical thinking
- 'Hands-on' and 'minds-on' activities
- Abstract and concrete experiences
- The cognitive demands of mathematical tasks

Week 6

Methods of teaching mathematics

- Deductive method
- Inductive method
- Problem-solving
- Learning mathematics with manipulatives and visual aids

Week 7

Methods of teaching mathematics (*contd.*)

- Project method
- Heuristic method
- Peer-teaching
- Demonstration

Week 8

Exploring mathematical concepts using ICT in mathematics: Digital tools for learning mathematics

- Incorporating ICT in mathematics teaching
- Encouraging mathematics teachers to use ICT
- Locating resources for using ICT

Week 9

- Communication in the mathematics classroom
- Teaching core vocabulary in advance
- Connections (establishing relationships among ideas and facts)
- Representation: Abstraction and symbolic representation

Unit 3: Planning, teaching and sequencing mathematical content (6 weeks)**Description**

This unit is related to the actual planning for the dissemination of pedagogical content knowledge and skills in mathematics. It helps Student Teachers develop, plan, and implement the required tasks and activities. It will also guide them in managing, using, and developing resources. This unit will try to contextualize tasks and activities according to the local environment. In the end, it takes effort to fill the gap between theory and practice in mathematics education.

Unit outcomes

This unit will enable Student Teachers to:

- learn the basic rules for mathematical sequencing in light of the National Curriculum for Mathematics;
- develop unit plans by taking informed decisions about what to teach and how to teach and assess it;
- develop lesson plans aligned with the unit aims and objectives, integrating appropriate ICTs and other teaching aids;
- develop relevant assessment items to assess students' learning;
- plan to manage resources and time effectively while implementing lesson plans;
- develop low-cost resources for learning mathematics for conceptual understanding;
- identify the strengths available in the local context and utilize them in planning for teaching;
- effectively plan, develop, and implement tasks and activities in their classrooms;
- set up a mathematics classroom that can facilitate students' learning;
- plan tasks and activities using ICT tools in teaching mathematics; and,
- review the research on teaching mathematics.

Week 10

- Building an understanding of the National Curriculum of Mathematics

- Fundamentals of mathematical content sequencing
 - Relating different mathematical contents and concepts
 - Prerequisites and expertise required for different mathematical content areas

Week 11

Bridging the gap between theory and practice

- Identifying current teaching practices using research on mathematics education
- What does research say about teaching approaches?

Week 12

- The difference between assessment and evaluation
- Understanding the purposes and tools of assessment
- Different types of assessment
 - Formative assessment
 - Portfolio
 - Project work
 - Mathematical investigation
 - Summative assessment
- Test and rubric construction
- Designing questions to promote thinking

Week 13

Contextualizing the content and tasks

- Identifying the student's local context
- Making language comprehensible in the local context
- Designing the learning environment in the local context
 - Learner-centred environment
 - Knowledge-centred environment
 - Assessment-centred environment
 - Community-centred environment

Week 14

- Resource management
 - Mathematics laboratory
 - ICT
- Time management
- Handling students' responses

Weeks 15 and 16

- Key components of unit planning
- Different models of lesson planning
 - LES (Launch, Explore, and Summarize)

- 5E (Engage, Explore, Explain, Elaborate, and Evaluate)
- 4P (Preparation, Presentation, Practice, and Production)
- MTA (Motivate, Teach, and Assess)
- Developing unit plans with integrated lesson plans to achieve the unit aims and objectives
- Micro- or peer-teaching
- Reviewing the unit planning based on the received feedback

Course assignments

Group assignment

Choose any mathematician of your choice and prepare a term paper detailing his/her:

- contributions to the field of mathematics
- beliefs, views, conceptions, and ideas about the nature of mathematics and teaching mathematics.

Individual assignments

- Select a concept from the National Curriculum of Elementary Mathematics and prepare a unit plan, including detailed lesson plans with activities, resources, and reading material.
- Present the unit plan.
- Review research-based articles and articulate lessons learnt for teaching and learning mathematics.
- Summative test

Grading policy

A variety of assessments will be used, including midterm and final examinations.

Ongoing assignments	60%
Midterm and final term test	40%

References

Textbooks, journal articles, and web resources are included in this section.

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