**University of Management and Technology**

**Course Outline**

Course code…… ED-770

Course title: **Knowing and Learning in Science and Mathematics**

|  |  |
| --- | --- |
| Program | MPhil Education |
| Credit Hours | 3 |
| Duration | 16 Weeks |
| Prerequisites |  |
| Resource Person |  |
| Counseling Timing  (Room# ) |  |
| Contact |  |

**Chairman/Director signature………………………………….**

**Dean’s signature…………………………… Date………………………………………….**

**Learning Objectives**

After completion of the course the students will be able to:

* construct models of knowing and learning to guide classroom practice.
* articulate various standards for knowing mathematics and science and articulate the implications of these standards for assessment, especially standardized assessment.

describe various paradigms for evaluating science and mathematics understanding.

* able to evaluate science and mathematics content and apply it to the correct learning environment.
* describe the links between knowing and developing in learning theory and the content and evolution of scientific ideas.

**Learning Methodology:**

The course will be taught using a variety of techniques and modes including on-campus lectures, discussions, reading assignments, presentations, group work, and research projects.

**Grade Evaluation Criteria**

Following are the criteria for the distribution of marks to evaluate the final grade in a semester. This is a tentative distribution, which may vary as per directions from the competent authority of UMT.

**Marks Evaluation Marks Percentage**

Quizzes 10

Assignments 10

Mid Term/Project(s) 20

Presentation 15

Attendance 05

Class Activity 05

Viva Voce 05

Final Exam 30

**Recommended Text Books:**

Felder, R. M., & Brent, R. (2016). *Teaching and learning STEM: A practical guide*. John

Wiley & Sons.

MacDonald, A., Danaia, L., & Murphy, S. (2020). *STEM Education Across the Learning*

*Continuum*. Springer.

National Research Council. (2001). *Knowing and learning mathematics for teaching:*

*Proceedings of a workshop. Continuum*. Springer.

Ogborn, J., Kress, G., & Martins, I. (1996). *Explaining science in the classroom*. McGraw-

Hill Education (UK).

**Reference Books:**

Black, P., & Wiliam, D. (2001). Inside the black box: Raising standards through classroom

assessment (London, School of Education, King's College London).

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn* (Vol. 11).

Washington, DC: National academy press.

Gonzalez, H. B., & Kuenzi, J. J. (2012). *Science, technology, engineering, and mathematics*

*(STEM) education: A primer*. Washington, DC:

Hanauer, D. I., & Curry, M. J. (2014). Language, Literacy, and Learning in STEM

Education. *Language, Literacy, and Learning in STEM Education*, 1-196.

Information Resources Management Association (Ed.). (2014). *STEM Education: Concepts,*

*Methodologies, Tools, and Applications*. IGI Global.

Kenney, J. M., & Hancewicz, E. (2005). *Literacy strategies for improving mathematics*

*instruction*. ASCD. Kracht, M. (2003). *The mathematics of language* (Vol. 63). Walter de

Gruyter.

Leahy, A. M. (1961). Nature-nurture and intelligence.

Sowder, J., & Philipp, R. (1999). Promoting learning in middle-grades mathematics.

In *Mathematics classrooms that promote understanding* (pp. 101-120). Routledge.

Sprenger, M. (2010). *Brain-based teaching in the digital age*. ASCD.

Walsh, J. A., & Sattes, B. D. (2005). How can quality questioning transform classrooms?

questioning to advance thinking, learning, and achievement. *Quality questioning:*

*research-based practice to engage every learner. Thousand Oaks (CA): Sage Publications*.

**Other References**

Chappuis, S., & Chappuis, J. (2007). The best value in formative assessment. *Challenging the*

*Whole Child: Reflections on Best Practice in Learning, Teaching and Leadership*, 219-226.

Feynman, R. P., & Sackett, P. D. (1985). ‘‘Surely You’re Joking Mr. Feynman!’’Adventures of a

Curious Character. *American Journal of Physics*, *53*(12), 1214-1216.

Kenney, J. M., Hancewicz, E., Heuer, L., Metsisto, D., & Tuttle, C. L. (2005). Mathematics as

language. *Literacy strategies for improving mathematics instruction*, 1-8.

Marx, G., & Gilon, C. A. (2022). of the Atkinson-Shiffrin (As) Mathematical Model of Human

Memory. *Int J Psychiatr Res*, *5*(1), 1-5.

Munson, L. (2011). What Students Really Need to Learn. *Educational Leadership*, *68*(6), 10-14.

Ritchhart, R., & Perkins, D. (2008). Making thinking visible. *Educational leadership*, *65*(5), 57.

Shaywitz, S. E. (1996). Dyslexia. *Scientific American*, *275*(5), 98-104.

Wilcox, J., Kruse, J. W., & Clough, M. P. (2015). Teaching science through inquiry. *The Science*

*Teacher*, *82*(6), 62.

**Calendar of Course contents to be covered during the semester**

**Course Code****:** ED 770

**Course Title**: **Knowing and Learning in Science and Mathematics**

|  |  |  |
| --- | --- | --- |
| **Weeks** | **Course Contents** | **Reference Chapter(s)** |
| 1 | **Beliefs About Knowing, Learning & Understanding**  • What is Knowing and Understanding?  • Course Introduction and Overview  • Syllabus Overview | What is Accountable Talk, Institute for Learning, Pam Goldman. |
| 2 | **Responsible Learning/ Responsible Teaching**  • What is Accountable Talk?  • Intro to Learning Environments | How Students Learn: Science in the Classroom Chapter 1 Pages 1- 26  Benny's Conception of Rules and Answers in IPI Mathematics, S. H. Erlwange |
| 3 | **Learning Environments & Three Principles of Learning**  • What are the Three Principles of Learning?  • What are Learning Environments?  **Thinking and Understanding Using Models in the Classroom**  • Why Use Models in the Classroom?  • How does the use of models help with Thinking and Understanding?  • What Learning Environments are present? | Making Thinking Visible, Ron Ritchhart, Chapter 1 Pages 3-22 |
| 4 | **Making Thinking Visible**  • What is Meant by Making Thinking Visible? | - Vygotsky’s Sociocultural Perspective, Woolfolk - Piaget, http://webspace.ship.edu/ cgboer/piaget.html - Kolb - Learning Styles, Saul McLeod - Erik Erikson's Stages of Psychosocial |
| 5 | **Foundations of Assessment** | Educational Leadership, The Best Value in Formative Assessment Inside the Black Box, Black and Wiliam, 2001 |
| 6 | **Questioning Strategies** | How Can Quality Questioning Transform Classrooms? Chapter 1, Pages 1-21 |
| 7 | **Child/Cognitive Development** | Reading from Piaget, Vygotsky, Kolb, Erikson and Gardner |
| 8 | **Nature vs Nurture**  • Is Learning due to Nature or Nurture? (Watson and Bandura) The Development of Expertise | - Nature vs Nurture in Intelligence http://wilderdom.com/personality/ L4-1Intelligence  Nature VsNurture.html - Dyslexia. Sally E. Shaywitz, Scientific American |
| 9 | **Dyslexia Instruction**  **Novice and Expert** | How People Learn, Chapter 2, How Experts Differ from Novices, Pages 31-50  Human Memory Atkinson-Shiffrin Model, http://users.ipfw.edu/ abbott/120/AtkinsonShifrin.html |
| 10 | **Brain-Based Learning and Memory**  **Learning and Transfer** | How People Learn, Chapter 3, Learning and Transfer, Pages 51- 78 |
| 11 | **Learning Theory I – Behaviorism**  **Learning Theory II – Constructivism** | Surely You’re Joking Mr. Feynman, Pages 211-219  Promoting Learning in Middle-Grades Mathematics, Sowder and Philipp, Pages 89-107 |
| 12 | **Mathematics Instruction**  **Science Instruction** | Helping Children Learn Mathematics, Chapter 4, Pages 115-155  Teaching Science Though Inquiry, The Science Teacher, Sept 2015, Pages 62-67 |
| 13 | **How Students Learn Literacy Instruction in Mathematics**  **How Students Learn Literacy Instruction in Science** | Literacy Strategies for Improving Mathematics Instruction:  Chapter 1 - Mathematics as Language, Joan M. Kenney  Chapter 2 - Reading in the Mathematics Classroom, Diana Metsisto  Educational Leadership: What Students Need to Learn: Teaching Science Literacy  Strategies for the Phases of Cognitive Processing |
| 14 | **Technology Basics** | Brain-Based Teaching in a Digital Age, Chapter 1, Pages 3-15, Sprenger |
| 15 | **Final Exam Review** | **Students Presentations** |