



## Lahore University of Management Sciences

### Course Code – STEM Teaching in the AI Era

Fall 2024

Possible Instructors	Anusheh Attique, Dr. Hamad Alizai,
Room No.	TBA
Office Hours	TBA
Email	TBA
Telephone	TBA
Secretary/TA	TBA
TA Office Hours	TBA
Course URL (if any)	TBA

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75mins
Recitation/Lab (per week)	Nbr of Lec(s) Per Week	N/A	Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week	N/A	Duration	

Course Distribution	
Core	N/A
Elective	Yes
Open for Student Category	TBA
Close for Student Category	

COURSE DESCRIPTION
<p>This course is designed to provide future STEM faculty, with an introduction to effective teaching strategies and the research that supports them. The goal is to equip the next generation of STEM faculty to be effective teachers, thus improving the learning experience for the thousands of students they will teach.</p> <p>This course is intended for graduate students and post-doctoral fellows across the STEM disciplines who want to develop as skilled, thoughtful, and confident teachers in Higher Education. The goal of this course is to challenge and broaden participants' concepts of learning and approaches to teaching. Sessions will be literature-informed but activity and discussion-based with an expectation of a high degree of collaboration and participation. The course has been organized in such a way as to balance theory and practice and to support both conceptual and skill development.</p> <p>As part of the development experience, you will articulate a teaching philosophy statement to document your approach to teaching. Please note: Guest lecturers may also be invited on occasion to lead a session. <b>Please note: This is a tentative course outline and may undergo some changes.</b></p>

COURSE OBJECTIVES
<ul style="list-style-type: none"><li>• The goal is to equip the next generation of STEM faculty to be effective teachers, thus improving the learning experience for the thousands of students they will teach.</li><li>•</li><li>•</li></ul>



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Learning Outcomes	
• • •	<p><b>By the end of the course, learners will be able to:</b></p> <ol style="list-style-type: none"><li>1. Reflect on their identity as a teacher, including beliefs about teaching and learning and writing their teaching philosophy statement</li><li>2. Apply principles of learning to develop student-centered STEM courses for institutions of higher education.</li><li>3. Adopt and Adapt a learning centered approach to teaching a variety of students in higher education</li><li>4. Engage with and adapt active learning techniques and facilitation skills</li><li>5. Select and implement a variety of instructional and assessment practices that are aligned with student learning</li><li>6. Discuss and critique theory, issues and good practices in learning and teaching</li><li>7. Provide and receive peer and instructor feedback</li><li>8. Apply principles and tools needed to ensure effective and relevant assessment and course design</li></ol>

Grading Breakup and Policy	
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	<p><b>Course Assessment and Assignments:</b></p> <p><b>Assignment 1: Syllabus Review and Annotation</b> First impressions are crucial and that applies to our courses, too! Analyzing and annotating course syllabi is a way for us to begin unpacking the many elements that contribute to building an open and welcoming classroom community, establishing norms and expectations, and using evidence-based practices.</p> <p><b>Assignment 2: Reflective Writing</b> This is just a single course in your journey towards becoming an effective educator. It's important that you become an independent learner and advocate for your own professional development. You will write regularly, reflecting on your learning and experiences, your reactions and feelings, your ideas and wonderings.</p> <p><b>Assignment 3: Classroom Observations</b> One of our objectives in this course is to challenge your notions of what effective teaching practices are. This is difficult when many of us experienced traditional classrooms - primarily lecture-based with a few tests along the way. I've identified several outstanding instructors for you to observe; their classrooms provide a glimpse into what can be in STEM courses.</p> <p><b>Assignment 4: Annotated Bibliography OR Course Design</b> Effective teaching isn't an art or a happy accident. Well, sometimes it is! But it's also a science, backed by evidence. Annotating peer-reviewed articles will help you develop familiarity with education research so you can continue to grow as a practitioner. If course design, then redesign a course you have studied or want to teach in the future. Create a course outline using the integrated course design principles learnt in class.</p> <p><b>Assignment 5: Teaching Philosophy Statement</b> Nearly all academic jobs require a teaching philosophy statement. This is a thoughtfully crafted, reflective statement describing what you believe about teaching and learning. In this course, we will work on getting your first draft written</p>
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**Assignment 6: Teaching Dossier**  
 Many jobs - and for you to also receive the faculty certificate in teaching and learning (FCTL) from the LLI - ask you to submit a portfolio that demonstrates your ability to effectively teach. In this course, you'll begin developing your portfolio

**Capstone Project: Teaching Module** At the end of our course, you'll have the opportunity to work with a small group of your peers to develop and implement a small teaching module. This is an opportunity to demonstrate your ability to use evidence-based teaching practices, get feedback, and launch your journey into STEM teaching in higher education.

Examination Detail	
Midterm Exam	Yes/ <b>No</b> : Combine Separate: Duration: Preferred Date: Exam Specifications:
Final Exam	Yes/ <b>No</b> : Combine Separate: Duration: Exam Specifications:

COURSE OVERVIEW			
Week/ Lecture/ Module	Week-wise theme	Topics	Application/ Recommended Readings
<b>Module 1: Principles of Teaching and Learning</b>	<b>Week 1: Intro to course</b>  <b>What is Learning:</b> Describing the Process of Learning  <b>Principle of learning 1:</b> Prior Knowledge  <b>Principles of learning 2:</b> Knowledge Organisations	Student misconceptions e.g. in Physics, Importance of Mental Models, Catalogue and Categories of Misconceptions, How to Activate Prior Knowledge, Knowledge Organization (The Big Picture in e.g. Genetics-) etc	Explore a few key principles of learning drawn from cognitive and psychological science research. You'll hear from experienced STEM instructors about how these learning principles play out in their classrooms. You will get the opportunity to explain these principles and discuss teaching practices that tap into them. And we'll ask you to reflect on your own experiences as learners to better understand these principles and set the stage for future weeks of the course.  <b>Reading:</b>  Freeman et al (2014)  Brown, Peter C. Make It Stick : the Science of Successful Learning. Cambridge, Massachusetts :The Belknap Press of Harvard University Press, 2014
	<b>Week 2 Guiding principles of teaching and learning</b>  <b>How do we learn?</b> (Constructivism, Social Constructivism, Metacognition and self regulation)		



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	<p><b>How do we structure learning opportunities?</b> (Retrieval Practice and More!)</p> <p><b>Principle of Learning 3:</b> Practice and Feedback</p> <p><b>Principle of Learning 4:</b> Student Motivation and Learning</p>		
	<p><b>Week 3</b></p> <p>Introduction to Teaching Philosophy</p> <p>Teaching Philosophy peer feedback</p> <p>Scholarship of Teaching and Learning</p>		<p><b>Readings:</b></p> <p>Palmer. P (1998). <i>The heart of a teacher. Identity and integrity in teaching</i> (pp. 1-17).</p> <p>Thomas. L. &amp; Beauchamp, C. (2011). <i>Understanding new teachers' professional identities through metaphor</i> (pp. 762-769)</p> <p>Ahmad, et al. (2017). Reframing teaching philosophy statements to learning philosophy statements (pp.1-20)</p>
	<p><b>Week 4</b></p> <p>Principles of Backward Design + Constructive Alignment with Learning Outcomes</p>		<p><b>Readings:</b></p> <p>Biggs, J. (1996). Enhancing Teaching through Constructive Alignment.</p> <p>Developing Effective Learning Outcomes: A Practical Guide from Queen's University (optional, good resource)</p>
<p><b>Module 2: Integrated Course Design</b></p>	<p><b>Week 5</b></p> <p>Active and Signature Pedagogies</p>	<p>Insights into difficulties a professor can face when using didactic instruction</p> <p>Fundamentals of Active Learning and Engagement in STEM</p> <p>Introduction to Signature Pedagogies in STEM Disciplines</p> <p>Designing and Implementing Active Learning Experiences</p>	<p>You will go through the foundational theories and practices behind active learning, emphasizing student engagement, participation, and the practical application of knowledge. Additionally, you will explore signature pedagogies—distinctive teaching methods that are characteristic of and essential to each STEM discipline, shaping the ways in which future professionals are educated. Through interactive discussions, case studies, and hands-on activities, you will learn how to implement these pedagogical approaches to enhance student learning and foster a deeper understanding of STEM subjects.</p> <p><b>Readings:</b></p>



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			Prince, M. (2004). Does Active Learning Work? A review of the Research
	<p><b>Week 6</b></p> <p>Assessment and Rubric Design</p>	<p>Principles of good assessment design</p> <p>Good practice for rubric development</p> <p>How instructors can adapt traditional homework problems or assignments to give students a deeper or a higher level understanding of the concept while keeping them engaged in the assignment</p>	<p>You will learn about the various roles assessment plays in STEM learning. A number of strategies for designing effective assessments of student learning will be introduced to you. This week includes several writing activities intended to help you start to apply the principles and practices</p>
<p><b>Module 3: Diversity Equity and Inclusion in STEM</b></p>	<p><b>Week 7</b></p> <p>Inclusive pedagogy in STEM</p>	<p>Why is Inclusive Teaching Important in STEM</p> <p>Hesitancies Instructors can have to engage in Inclusive Teaching</p> <p>Describe and explain the 'WAVE' and 'UDL' model for thinking about inclusive education</p> <p>Students will become familiar with a range of pedagogical approaches that promote active learning and inclusivity</p>	<p>You will engage with key concepts in inclusive teaching and learn from experts in higher education who share their important research on student development, microaggressions, stereotype threat, and Universal Design for Learning. You will be equipped with tools to help you develop inclusive courses/classrooms that support all learners.</p>
<p><b>Module 4: Lesson Planning and Delivery</b></p>	<p><b>Week 8</b></p> <p>Models of Course and Lesson Design, and the Syllabus</p> <p>Giving and Receiving Feedback</p>		
<p><b>Module 5: Technology Enhanced Learning</b></p>	<p><b>Week 9</b></p> <p>Role of AI in Education</p> <p>What does teaching and learning look like in the age of AI: student and faculty perspectives</p>	<p>Role of AI in Education</p> <p>Flipped Classrooms in STEM</p>	<p>You will explore the transformative role of Artificial Intelligence (AI) in the educational landscape. This module delves into the fundamental concepts of AI and its applications in enhancing teaching methodologies, personalizing learning experiences, and addressing challenges unique to STEM education. You will critically examine the potential benefits and ethical considerations of integrating AI tools into your teaching practices. Through a combination of theoretical insights and practical examples, this module aims to equip educators with the knowledge to incorporate AI technologies into their classrooms, thoughtfully fostering a more</p>



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			<p>engaging, effective, and inclusive learning environment.</p> <p><b>Resources:</b> Khan Academy Book on AI in Education</p>
	<b>Week 10</b>	<p>Hybrid + Large Classrooms in STEM</p> <p>Effective teaching strategies in Large Classrooms</p> <p>Designing Engaging Hybrid Experiences</p> <p>Overcoming challenges: Engagement, Assessment in Large classes and Hybrid format</p>	<p>As educational environments become more diverse and technologically integrated, understanding how to effectively navigate and leverage these formats is crucial. You will explore strategies for managing large groups of students, fostering interaction and engagement in hybrid settings, and employing AI and technology to enhance learning outcomes. By the end of this section you will be better equipped to create dynamic, inclusive, and effective learning environments, regardless of class size or format.</p>
<b>Module 6: University of the Future</b>	<b>Week 11</b>  Future of work and the university of the future	<p>Assessments and AI (Preparing Students for a Future with Increased Automation and AI)</p> <p>Trends Impacting the Future of Work and Implications for STEM Education</p> <p>The Role of Universities in Fostering Workforce Readiness and Lifelong Learning</p> <p>Innovations in Curriculum Design to Meet Future Workforce Demands</p>	<p>This module delves into current trends affecting the future of work, such as automation, artificial intelligence, and the gig economy, and discusses how these trends necessitate changes in university curricula, teaching methodologies, and student engagement strategies. You will engage in forward-thinking discussions and activities aimed at envisioning the university of the future—one that will equip you not just with technical skills, but with the adaptability, critical thinking, and lifelong learning capabilities needed to thrive in a rapidly changing world.</p> <p>Watch/Discuss: The 5 Minute University- <a href="https://www.youtube.com/watch?v=e00G1Pvns31U">https://www.youtube.com/watch?v=e00G1Pvns31U</a></p> <p>Watch Mazur Assessment videos: <a href="https://www.youtube.com/watch?v=C.Bzn9RAJG6Q">https://www.youtube.com/watch?v=C.Bzn9RAJG6Q</a></p>



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<b>Capstone Project-Teaching Module</b>	<b>Week 12</b>	<p>This is a part of the <b>Capstone Project: Teaching Module</b> as mentioned in assessments section of the course outline. At the end of our course, you'll have the opportunity to work with a small group of your peers to develop and implement a small teaching module. This is an opportunity to demonstrate your ability to use evidence-based teaching practices, get feedback, and launch your journey into STEM teaching in higher education. In this project, you will describe the learning goals, formative and summative assessments, and instructional activities for an instructional module. This could be an entire class period, a small portion of that class, or an entire week's worth of class meetings, whatever constitutes a coherent 'module' for you.</p>	
	Capstone Project - Teaching Module		
	<b>Week 13</b>		
	Capstone Project - Teaching Module		
	<b>Week 14</b>		
	Course Summary and Takeaways		

Textbook(s)/Supplementary Readings
<p>“Successful Science and Engineering Teaching: Theoretical and Learning Perspectives” Calvin S. Kalman, published by Springer</p> <p>Facilitating Experiential Learning in Higher Education Teaching and Supervising in Labs, Fieldwork, Studios, and Projects  <a href="https://www.routledge.com/Facilitating-Experiential-Learning-in-Higher-Education-Teaching-and-Supervising/Tormey-Isaac-Hardebolle-Duc/p/book/9780367620325">https://www.routledge.com/Facilitating-Experiential-Learning-in-Higher-Education-Teaching-and-Supervising/Tormey-Isaac-Hardebolle-Duc/p/book/9780367620325</a></p>

### Required Resources:

1. **Textbook.** No textbook is required for this course. We will read excerpts from various books and peer-reviewed journal articles - this is intentional as we want to become familiar with *evidence-based practices*. All readings are available through Perusall.
2. **Perusall.** Reading scientific literature is critical to research *and teaching*. This is how we ‘stand on the shoulders of giants’. To help build our classroom community, we will use an online platform, *Perusall*, to annotate all readings collaboratively. *Perusall* is a social platform, so annotations you make are shared with the class - and we can all respond to each other’s annotations. I established our class in Perusall and the access code to associate with the course will be shared with you on the first day of the course. Some of you may be familiar with Perusall and already have an account. You can use that same account. If this is your first time using Perusall, you will need to create an account. Then use that access code to find our course. Thanks!
3. **Laptop.** A laptop is not essential, but it is really helpful in this class. We will use a variety of software, relying primarily on Google Drive and related applications. However, from time to time, we may ‘try out’ new software to investigate how it facilitates (or hinders!) teaching and learning.



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4. **Open, positive attitude.** I request you to keep an open mind about this course. Many of us are very independent and self-motivated learners – but that is not the norm for our undergraduates. Be open to new ideas about teaching and learning and keep in mind that other disciplines have some good ideas, too!