COURSE SYLLABUS

ILSE 652 Mathematics Education

Semester A (2022), 3(3-0-6) credit hours

Course Coordinator

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Instructors

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Crouse Description

ธรรมชาติการเรียนวิชาคณิตศาสตร์ แนวคิดที่คลาดเคลื่อนทางคณิตศาสตร์ การบูรณาการความรู้และศาสตร์การ
สอนเพื่อจัดการเรียนรู้ความน่าจะเป็นและสถิติ ตรรกศาสตร์เบื้องต้นและวิธีการพิสูจน์ จำนวนจริงและจำนวนเชิงซ้อน
เรขาคณิต พีชคณิต แคลคูลัส

Nature of learning mathematics; misconceptions in mathematics; pedagogical content knowledge
for teaching probability and statistics, logic and mathematical proof, real and complex numbers, geometry,
algebra, calculus

Course Learning Outcomes (CLO)

Students will be able to:

Course Learning Outcome (CLO)	Expected Learning Outcome (ELO)	Sub-ELO
CLO1: Clarify nature of learning mathematics	ELO 1 ELO 6	sub-ELO 1.1 sub-ELO 6.4 (Ph.D.)
CLO2: Analyze mathematics content under PCK framework	ELO 2	sub-ELO 2.2
CLO3: Propose a way to solve students' difficulties in mathematics learning	ELO 3	sub-ELO 3.1 and 3.2
CLO4: Evaluate in-depth of oneself knowledge in mathematics	ELO 6 ELO 7	sub-ELO 6.3 sub-ELO 7.2
CLO5: Design an instruction to improve students' learning in the selected mathematics topic	ELO 1 ELO 2	sub-ELO 1.1 sub-ELO 2.1, 2.2 and 2.3

Venue: Room 303 Institute for Innovative Learning (Online learning is also available for overseas students and in any circumstances where face-to-face meetings are not possible)

Online: https://mahidol.webex.com/mahidol/j.php?MTID=mf91524f9332ff66fa4eee5db567d145d

Meeting number: 2641 273 2702

Password: ILSE652

Host key: 852260

Course Outline (Thursday, 9.00-12.00)

Week	Date	Topic	Instructors	Teaching approaches	CLO
1	11 Aug	Knowing how students learn	WW	Discussion, Case study	CLO1
2	18 Aug	Nature of learning mathematics I	WW	Discussion, Case study	CLO1
3	25 Aug	Nature of learning mathematics II	WW	Discussion, Case study	CLO1
4	1 Sep	Learning theory in learning mathematics aspect	WW	Discussion, Case study	CLO1
5	15 Sep	Misconception in learning mathematics	WW	Discussion, Case study	CLO1
6	22 Sep	Pedagogical content knowledge (PCK) in mathematics	WW	Discussion, Case study	CLO1
7	29 Sep	*PCK for probability & statistics	WW	Discussion, Demonstration, Case study	CLO2, CLO3, CLO5
8	6 Oct	*PCK for logic & mathematical proof	WW	Discussion, Demonstration, Case study	CLO2, CLO3, CLO5
9	20 Oct	*PCK for real & complex numbers	WW	Discussion, Demonstration, Case study	CLO2, CLO3, CLO5
10	27 Oct	*PCK for geometry	WW	Discussion, Demonstration, Case study	CLO2, CLO3, CLO5
11	3 Nov	*PCK for algebra	WW	Discussion, Demonstration, Case study	CLO2, CLO3, CLO5

Week	Date	Topic	Instructors	Teaching approaches	CLO
12	10 Nov	*PCK for calculus	WW	Discussion, Demonstration, Case study	CLO2, CLO3, CLO5
13	17 Nov	Conceptual change in learning mathematics	WW	Discussion, Case study	CLO1
14	24 Nov	New trends in mathematics education	WW	Discussion, Case study	CLO1
15	1 Dec	Final examination	WW	Examination	CLO4

* Assignment

Readings

Committee on *How People Learn*, National Research Council (U.S.). (2005). *How Students Learn: Mathematics in the Classroom*. (M. S. Donovan & J. D. Bransford, Eds.) National Academies Press.

Dienes, Z. P. (1995). *Some Thoughts on the Dynamics of Learning Mathematics*.

Ellis, M. W. & Beery III, R. Q. (2005). The paradigm shift in mathematics education: Explanations and implications of reforming conceptions of teaching and learning. *The Mathematics Educators, 15* (1), 7 – 17.

Pirie, S. & Kieren, T. (1994). Growth in mathematical understanding: How can we characterize it and how can we represent it? *Educational Studies in Mathematics, 26*, 165 – 190.

Skemp, R. R. (1976). Relational understanding and instrumental understanding. *Mathematics Teaching, 77*, 20 – 26.

Tall, D. (1993). Success and failure in mathematics: The flexible meaning of symbols as process and concept. *Mathematics Teaching, 142*, 6 – 10.

Class handouts.

Course Requirements

For credit registration

- **Class attendance and participation (10%) To evaluate CLO1**

  Each student is expected to discuss and analyze the concepts presented during the learning activities and oral presentations.

- **Class assignments (70%) to evaluate CLO2, 3, and 5**

  From time to time, there will be assignments such as searching for information to extend the concepts learned in class or applying the concepts to various situations. In Week 7 -12, each student is assigned to prepare teaching and demonstrate the teaching in the class. Verbal feedback will be provided at the end of the student's presentation.

- **Final examination (20%) to evaluate CLO4**

  At the end of this class, each student will be assessed the mathematical content by written exam.

Final grades will be determined as follows:

>= 85%	A,
>= 75 and <85%	B$^+$,
>= 65 and <75%	B,
>= 55 and <65%	C+, and
< 55%	I

In addition, a student's final grade may be higher than the suggested guideline if the student's score is close enough (<1% gap) to the next higher score. That is, close scores will likely earn the same final grade.

For audit registration

- **Class attendance and participation**

  For audit students to get a passing grade, they are required to attend at least 80% of class time (13 out of 16 sessions) with active participation as required for credit students.

- **Class assignments**

  Also, it's mandatory for audit students to complete assignments given by the instructors. In Week 7-12, each student is assigned to prepare teaching and demonstrate the teaching in the class (at least one mathematical topic).

Rubric for class participation

	Present (1)	Attentive (2)	Engaging (3)	Satisfactory (4)	Exemplary (5)
Active contribution	Show up but never contribute to class discussion	Seldom contribute to class discussion, unless asked	Occasionally contribute to class discussion	Regularly contribute to class discussion	Proactively and regularly contribute to class discussion
Active listening	Lack of attention to the discussed topic	Listen when others discuss and occasionally respond to the discussed topic	Listen when others discuss and sometimes respond to the discussed topic	Appropriately listen when others discuss and consistently respond to the discussed topic	Appropriately listen when others discuss and usefully respond to the discussed topic

Criteria for assignment

- **Mathematics knowledge**: well understand the topic in breadth and depth (10 points)

- **Pedagogical mathematics content knowledge:** show ability to use the teaching approach for driving mathematics content knowledge (15 points)

- **Efforts:** effective response to questions and discussion during presentation, and well prepare the assignment or activities (15 points)

The PLOs and key performance indicators of the Master of Science Program in Science and Technology Education (International Program) in Academic Year 2020.

PLOs	Key Performance Indicators
PLO 1: Display moral and ethical behavior for science and technology educators	1.1 Display moral and ethical behavior that aligns with the code of conduct for science and technology educators 1.2 Follow the ethical code of conduct in educational research
PLO 2: Apply principle in science and technology education to design and implement learning activities in science and/or technology classes appropriately	2.1 Adopt instructional sciences to improve learning in science and technology education 2.2 Design learning activities for science and/or technology classes 2.3 Implement the designed activities to improve learning in science and technology education 2.4 Assess students' learning achievement
PLO 3: Synthesize solutions to learning problems in the field of study	3.1 Analyze learning problems in the field of study 3.2 Apply PLO 2 to synthesize new ways and/or means to solve the learning problems
PLO 4: Conduct science and technology education research by integrating knowledge in the field of study	4.1 Propose a research project in science and technology education predicated on educational research methodology 4.2 Conduct science and technology education research 4.3 Publish an international peer-reviewed research article
PLO 5: Improve innovations in science and technology education consistent to knowledge in the field of study and social contexts	5.1 Display ability to search for existing innovations in science and technology education consistent to knowledge in the field of study

PLOs	Key Performance Indicators
	5.2 Analyze strengths and weaknesses of the existing innovation
	5.3 Propose ways and/or means to improve the existing innovation
	5.4 Use the improved innovation for others' benefits and/or applicable to social contexts
PLO 6: Evaluate knowledge of oneself	6.1 Classify criteria for self-evaluation
	6.2 Reflect oneself against the criteria
	6.3 Evaluate oneself validly and reliably
PLO 7: Display the ability to control and improve oneself	7.1 Display the ability to control oneself
	7.2 Display the ability to improve oneself
PLO 8: Display leadership quality and ability to effectively collaborate with others	8.1 Display leadership quality to effectively collaborate with others
	8.2 Display ability to effectively collaborate with others