

**Course Syllabus**  
**ILSE 600 Instructional Science**  
**Semester A (2022), 3 (3-0-6) credit hours**

**Course coordinator:** Asst.Prof.Piyachat Jittam, Ph.D. (Science and Technology Education)

**Office:** Institute for Innovative Learning, Panyapipat Building, Room 222

**Office hour:** By appointment

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**Instructor**

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**Course Description**

How students learn; learning theory; pedagogical content knowledge; effective teaching and learning approaches; instructional design theory and model; learner analysis; learning level and assessment; classroom management; principle, concept, and guidelines for constructing lesson plan; ethics in teaching and professional ethics; micro-teaching

**Course Learning Outcomes (CLOs)**

The students who attend this subject should be able to:

Course Learning Outcome (CLO)	ELO	Sub-ELO
1. explain learning theories and how students learn	2	2.1
2. explain an understanding of pedagogical content knowledge and instructional design theory and model in science	2	2.1
3. analyze pedagogical approaches in science and their strengths, weaknesses, and applications in the science classroom	3	3.1
4. propose effective methods to diagnose learners, learning level, and assessment and propose potential and effective ways to enhance learners' learning	2	2.4, 3.2

Course Learning Outcome (CLO)	ELO	Sub-ELO
5. explain effective classroom management in science	2	2.1, 2.2
6. explain and concerned about ethics in teaching and professional ethics	1	1.1
7. create effective lesson plan	2	2.1, 2.2, 2.4
8. perform microteaching to express a deep understanding of and competency in effective teaching strategies, materials, assessment, and classroom management	2	2.3, 2.4
9. express ability to continuously monitor and develop their own learning	6	6.1, 6.2, 6.3
	7	7.1, 7.2
10. work collaboratively and effectively with others	8	8.1, 8.2
11. utilize the computer, technology, and information technology in enhancing their learning in the course	2	2.1

**Class Periods:** Monday, 9.00-12.00 hr. and 13.00-16.00 hr.

**Room:** Smart Classroom (*Online learning is also available in any circumstances where fact-to-face meetings are not possible*)

<https://mahidol.webex.com/mahidol/j.php?MTID=mb896bd04313cc9a81ce629d2fc3a51f9>

Meeting number: 2642 070 3851

Password: ILSE600

Host key: 541699

### **Course Outline**

Week	Date	Topic	CLO	Teaching Approach	Instructor
1	<b>15 Aug 22</b> (9.00-9.20)	Introduction and course agreement		Lecture	PJ
	(9.20-12.00)	Science education reform & Science curriculum	9, 10	Active lecture & Discussion	PS <u>SS</u>
2*	<b>22 Aug 22</b> (9.00-12.00)	How students learn & Learning theory	1, 9, 10, 11	Active lecture & Discussion	PJ WK <u>WW</u>
3*	<b>29 Aug 22</b> (9.00-12.00)	Instructional design theory and model	1, 2, 9, 10, 11	Active lecture & Discussion	<u>CP</u> PJ
4*	<b>5 Sep 22</b> (9.00-12.00)	Pedagogical content knowledge	2, 3, 9, 10, 11	Active lecture & Discussion	KB <u>PJ</u>
5*	<b>12 Sep 22</b> (9.00-12.00)	Diagnosing students 'conceptions, perceptions, and learning styles	3, 4, 9, 10	Active lecture & Discussion	KB
6*	<b>19 Sep 22</b> (9.00-12.00)	Conceptual change	4, 9, 10	Active lecture & Discussion	KB
7*	<b>26 Sep 22</b> (9.00-10.00)	Teaching and teacher professional ethics	6, 9, 10	Active lecture & Discussion	MP TP <u>SS</u>
	(10.00-12.00)	Classroom management	5, 10, 11	Active lecture & Discussion	<u>KB</u> MP PC TP
	(11.00-12.00)	Guideline for writing lesson plan ( <i>submit the lesson plan (1<sup>st</sup> version) within 10 Nov 2022</i> )	7, 9, 11	Active lecture & Discussion	<u>KB</u> MP PC PJ TP SY

Week	Date	Topic	CLO	Teaching Approach	Instructor
8*	<b>3 Oct 22</b> (9.00-12.00)	Inquiry-based learning & Learning cycle	3, 9, 10, 11	Active lecture & Discussion	<u>PC</u> TP SY
9*	<b>17 Oct 22</b> (9.00-12.00)	Game-based learning	3, 9, 10, 11	Active lecture & Discussion	<u>NS</u> PJ WW
10*	<b>17 Oct 22</b> (13.00-16.00)	Blended learning	3, 9, 10, 11	Active lecture & Discussion	NS WK
11*	<b>31 Oct 22</b> (9.00-12.00)	- Project-based learning - STEM teaching and learning approach	3, 9,10, 11	Active lecture & Discussion	<u>NS</u> PJ
12*	<b>31 Oct 22</b> (13.00-16.00)	Problem-based learning	3, 9, 10, 11	Active lecture & Discussion	NS <u>PJ</u>
13*	<b>7 Nov 22</b> (9.00-12.00)	Formative and summative assessment in the science classroom	4, 9, 10	Active lecture & Discussion	PJ <u>WK</u> WW
14*	<b>7 Nov 22</b> (13.00-16.00)	Authentic learning and evaluation	4, 9, 10	Active lecture & Discussion	<u>PJ</u> WK
15	<b>14 Nov 22</b> (9.00-12.00)	Peer review lesson plan (submit the final lesson and ppt for microteaching within 21 Nov 2022)	7, 9, 10, 11	Peer review & Discussion	<u>KB</u> MP PC PJ TP SY
16	<b>28 Nov 22</b> (9.00-16.00)	Performing-microteaching	8, 9, 10, 11	Microteaching & Discussion	All

*Remark \* is a week for student's assignments (5 points each)*

### **Assessment and Evaluation**

Tools/Method*	CLO											Percentage (%)
	1	2	3	4	5	6	7	8	9	10	11	
Active participation										/		10
Assignment	/	/	/	/	/	/			/			40
Writing lesson plan							/		/		/	20
Peer review lesson plan							/		/	/	/	10
Microteaching								/	/	/	/	20

*(Remark: \* See the detail of assessments and their rubric criteria in the appendix)*

Final grade will be determined by the total points earned, that is,

- ≥ 90 - 100% = A
- ≥ 80 and < 90 % = B+
- ≥ 70 and < 80 % = B
- ≥ 60 and < 70 % = C+
- ≥ 50 and ≤ 60 % = C

*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.*

**Important remark:**

1. For credit students to get an evaluation, they must attend at least 80% of class time.
2. For audit students to get a passing grade, they must attend at least 80% of class time with active participation as the same as credit students. Also, the assignment given by instructors have to be included in this evaluation

**Readings:**

Readings will consist of articles drawn from the primary literature of science education and some chapters from the books, such as:

1. Bybee, R. W. (2002). *Learning science and the science of learning*. Allington, NSTA press.
2. Capraro, R.M. & Slough, S.W. (Eds.) (2009). *Project-Based Learning: An Integrated Science, Technology, Engineering, and Mathematics (STEM) Approach*. Rotterdam, The Netherlands.
3. Lederman, N.G., & Newsome, J.G. (2001). *Examining pedagogical content knowledge*. Dordrecht, Kluwer Academic Publishers.
4. National Research Council. (2005). *How Students Learn: Science in the Classroom*. Washington DC, The National Academies Press.
5. National Research Council. (2000). *Inquiry and the national science education standards: A guide for teaching and learning*. Washington D.C.: National Academic Press.
6. Savin-Baden, M. & Howell, C. (2004). *Foundations of problem-based learning*. The Society for Research into Higher Education & Open University Press.
7. Yager, R. (2009). *Inquiry: The key to exemplary science*. Arlington, NSTA Press.

Note: The instructors will provide copies of some handouts or articles.

## APPENDIX

### ▪ Active Participation (10%)

Each student is expected to participate actively in the class. The active participation will include questioning, sharing, discussing, questioning, participating in the learning activity, and working cooperatively.

#### *Scoring rubric for active participation*

	<b>Poor (1)</b>	<b>Fair (2)</b>	<b>Good (3)</b>	<b>Excellent (4)</b>
<b>Attendance and punctuality</b>	Attend class late or leave early ( $\geq 15$ min.)	Attend class late or leave early (not more than 15 min.)	Attend class on time.	Attend class early.
<b>Engagement</b>	Never contributes to class by offering ideas and asking questions.	Rarely contributes to class by offering ideas and asking questions.	Proactively contributes to class by offering ideas and asking questions once per class.	Proactively contributes to class by offering ideas and asking questions more than once per class.
<b>Listening, questioning, and discussing</b>	Not listen with respect, argues with classmates, and do not consider other ideas. Blocks group from reaching an agreement.	Trouble listening respectfully and taking over discussion without letting other people have a turn.	Respectfully listen, discuss and ask questions.	Respectfully listen, discuss and ask questions and helps direct the group in solving the problem.
<b>Preparation</b>	Not prepared with assignments and required class materials.	Prepare with assignments and required class materials rarely.	Prepare with most assignments and required class materials.	Prepare well with assignments and required class materials rarely.
<b>Problem-solving</b>	Not try to solve problems or help others solve problems.	Not offering solutions but is willing to try solutions suggested by the other group members.	Improves on solutions which other group members suggest.	Actively seeks and suggests solutions to problems.

### ▪ Assignments (40%)

There are **13 assignments** (*please refer to the symbol \* in the course outline table*). Each assignment is scored **5**. The total assignment score weighs 40% of the entire course score. The assignment's detail is different according to contents and learning objectives each week. The students are required to complete each assignment within the class. However, if time is not available, the assignment may be assigned as homework.

#### **Scoring rubric for assignment**

<b>Criteria*</b>	<b>Unacceptable (1)</b>	<b>Marginal 2</b>	<b>Fair 3</b>	<b>Acceptable 4</b>	<b>Exceptional 5</b>
Content knowledge	The response is completely incorrect or irrelevant.	The application, if attempted, is irrelevant.	The application of the concept to the practical problem or task is adequate.	The concept has been applied to practical problems or tasks.	Effective application of the concept to a practical problem or task reveals insight

Criteria*	Unacceptable (1)	Marginal 2	Fair 3	Acceptable 4	Exceptional 5
					into the biology education principle
Ethical behavior	No evidence that the students consider ethical concerns.	Students appear to be aware of some ethical issues but do not fully understand what it means to work ethically and professionally.	Students demonstrate understanding of the significant ethical issues and not full responsibility to work ethically and professionally.	Students demonstrate an understanding of the significant ethical issues and are responsible for working ethically and professionally.	Students can analyze a complex ethical situation and demonstrate an understanding of significant and subtle ethical issues. They also show moral and professional teaching in their response

*Remark:* \* The instructor may add another criterion according to contents and learning objectives in each week.

Weighing for each measure depends on the instructor.

▪ **Writing lesson plan (20%) and Peer review (10%)**

Each student must bring all of the understanding from this course to write two lesson plans for two different science subjects. The topics that should be included in the lesson plan are 1) topic, 2) level of target students, 3) time usage, 4) learning standards and indicators, 5) key content, 6) learning objectives, 7) teaching and learning activity (specify teaching techniques used), 8) learning assessment and criteria, and 9) teaching and learning materials. Students must submit the first version of the lesson plan within 10 Nov 2022. This first version will be used for peer-review on Week 15. After the peer review, the students are given opportunities to revise and submit the final version of a lesson plan within 21 Nov 2022.

***Scoring rubric for lesson plan***

Criteria	Unacceptable (1)	Developing (2)	Proficient (3)	Exemplary (4)
<b>Components</b>	Most components of the lesson plan are missing or inadequately addressed.	Some components of the lesson plan are missing or inadequately addressed.	All components of the lesson plan are included to a satisfactory level.	All components of the lesson plan are included and are of excellent quality.
<b>Objectives</b>	Objectives are not identified or not appropriate for the grade level, developmental level, or topic.	Objectives are appropriately identified but may not be specific, observable, and measurable.	Objectives are appropriately identified and specific, observable, and measurable	Objectives meet proficient criteria, are stated clearly, and relate to meaningful skills or concepts essential to student learning.
<b>Content knowledge</b>	<ul style="list-style-type: none"> <li>▪ Little familiar with the subject matter.</li> <li>▪ Proceed without considering misconceptions that students might have about the material.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Somewhat familiar with the subject matter.</li> <li>▪ Has a hunch about one or two ways students might become confused with the concept.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Know the subject matter well.</li> <li>▪ Anticipates misconceptions that students might have and plan to address them.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Demonstrate in-depth understanding of the subject matter and up to date.</li> <li>▪ Anticipate students' misconceptions and confusion and develop multiple strategies.</li> </ul>
<b>Instructional strategies</b>	The instructional plan is so vague or generalized that it is unusable.	The instructional plan may, at the time, be too vague or lacking elements or details	The instructional plan is straightforward and designed to promote critical thinking, inquiry	The instructional plan meets the proficient criteria, utilizes appropriate teaching

Criteria	Unacceptable (1)	Developing (2)	Proficient (3)	Exemplary (4)
		necessary for effective delivery of information; instructional strategies may rely too heavily on lectures or worksheets or may not facilitate the learning objectives.	learning, problem-solving strategies, or creativity; instructional strategies facilitate the learning objectives.	pedagogy, and includes guiding questions for engaging students in higher-level thinking.
<b>Learning materials</b>	Materials and resources are not listed.	Materials and resources are listed but may not be effectively implemented.	Materials and resources are listed and are effectively implemented.	Materials and resources are listed, and various resources and technological tools are effectively implemented.
<b>Assessment</b>	Assessment may be described, but the assessment tools are not included	The assessment tools are incorporated but do not reflect the objectives or be appropriate to the topic or grade level.	Some assessment tools and scoring criteria are included and reflect the objectives and be appropriate to the topic or grade level.	All assessment tools and scoring criteria are included, reflect the objectives, and be appropriate to the topic or grade level.

### *Scoring rubric for peer review lesson plan*

Unsatisfactory 1-2	Limited 3-4	Satisfactory 5-6	Good 7-8	Very good 9-10
No review was completed, or many items were not complete	The students demonstrate a brief review but no helpful feedback about what worked well and what could be improved	The students affirm the sound judgment with limited input about what worked well and could be improved.	The students demonstrate good review with constructive feedback on what worked well and could be improved.	The students demonstrate excellent reviews completed with very constructive feedback about what worked well and improved.

- **Performing micro-teaching (20%)**

After completing the teaching plan, the students must subsequently bring all of the understanding learned from this course to perform a 30-minute microteaching. The micro-teaching will be observed, assessed, and discussed for further improvement by instructors and peers.

### **Scoring rubric for microteaching**

Criteria	Marginal (1)	Fair (2)	Acceptable (3)	Exceptional (4)
<b>Learning Objectives</b>	Begin a lesson without presenting learning objectives or giving students a sense of where instruction is headed	Begin a lesson by giving students a sense of where instruction is headed	Tell students the objectives of the lesson	Show students exactly what's expected by posing observable objectives
<b>Connection</b>	Start the lesson without making it exciting or connecting it to things students already know	Making the lesson interests but not relating it to things students already know	Making the lesson interests and connecting it to things students already know	Activate student's prior knowledge and motivate their interest in the lesson
<b>Engagement</b>	Very few (or no) comprehension checks, little to no interaction, and no variety in modes of communication	Comprehension checks are too few or are not effectively used; interaction and modes of communication are lacking	Some modes of communication are used, pace or level may be slightly off, and comprehension checks are regular but don't	Appropriate pace, comprehension checks, relating to students, suitable for level, and interaction between teacher-student/student-student and all

Criteria	Marginal (1)	Fair (2)	Acceptable (3)	Exceptional (4)
			accurately gauge learning.	communication modes are used
<b>Materials and resources</b>	Use a limited range of materials and not integrate technology	Use a limited range of materials and technology	Use well-chosen materials and effective technology	Use well-chosen materials that connect to the 'real world' & variety effectively integrate technology
<b>Clarity</b>	Present material in a confusing way, using language that is inappropriate	Use language and explanations that are fuzzy, confusing, or inappropriate	Use precise explanations, appropriate language, and examples to present material	Present materials clearly and explicitly, with well-chosen examples and vivid, appropriate language
<b>Closure</b>	Move on at the end of the class since the timeout	Move on at the end of the lesson without closure or application to other contexts	Bring closure to the lesson and asks students to think about applications.	Have students sum up what they have learned and apply it in a different context

**Table for summary the summative assessment method used in this course and the expected learning outcomes (ELOs)**

Summative assessment	Sub-ELOs														Percentage	
	1.1	2.1	2.2	2.3	2.4	3.1	3.2	6.1	6.2	6.3	7.1	7.2	8.1	8.2		
Active participation														5.00	5.00	10.00
Assignment	3.08	9.23	3.08		3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08				40.00
Writing lesson plan		4.44	2.22		2.22			2.22	2.22	2.22	2.22	2.22				20.00
Peer review lesson plan		1.82	0.91		0.91			0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	10.00
Microteaching		2.00		2.00	2.00			2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	20.00
<b>Total</b>	3.08	17.49	6.21	2.00	8.21	3.08	3.08	8.21	8.21	8.21	8.21	8.21	7.91	7.91		100.00

**The PLOs and key performance indicators of the Master of Science Program in Science and Technology Education 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
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 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



PLOs	Key Performance Indicators
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