

## COURSE SYLLABUS

Institute for Innovative Learning, Mahidol University

**ILSE 659 Innovations in Science and Technology to Improve Learning (Ph.D.)**

**Semester B (2022), 3 (1-4-4) credit hours**

### Course coordinator:

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### Course Description:

Principle, concept, design, application, and development of innovation for improving science, mathematics, and technology learning process; morals and ethics in the development of innovation in science and technology education; morals and ethics in using innovation to develop learning process; quality of innovation in science and technology education

## Course Learning Outcomes:

The learners should be able to

Course Learning Outcome (CLO)	ELO	Sub-ELO
1. Analyze previous research work involving educational innovations and justify their use for development of learning process	5	5.1, 5.2
2. Apply knowledge in science, mathematics, or computer to develop a new instructional material (such as apparatus, experiment, or media) to promote students had better understanding of the concept	2	2.1-2.2
	5	5.1-5.4
3. Apply knowledge in education to design appropriate learning process integrated with the develop instructional material to enhance student's learning	2	2.1-2.2
	4	4.1
	5	5.1-5.4
4. Evaluate the developed instructional material for effective learning	2	2.3, 2.4
	4	4.1
	5	5.1-5.4
5. Enhance your in-depth conceptual understanding of scientific/mathematics, other concepts-related topics	6	6.1-6.4
6. Have morals and ethics in the development of innovations in science, mathematics, and technology education	1	1.1, 1.2
7. Have morals and ethics in developing of the learning process in science, mathematics, and technology	1	1.1, 1.2
8. Display self-control in class and in doing assignments	7	7.1

## Readings:

The readings assigned for this course consists of articles drawn from the former literature of science and technology education. The examples of journals recommended in this course are

- Science (<http://www.sciencemag.org/journals/>)
- Nature (<http://www.nature.com/nature/index.html>)
- Research in Science and Technology Education
- International Journal of Science and Mathematics Education
- Biochemistry and Molecular Biology Education
- Educational Technology Research and Development
- Innovations in Education and Teaching International
- Life Science Education
- Nurse Education Today
- Journal of Cell Biology Education
- Journal of Chemistry Education
- The Physics Teachers
- Computer & Education
- Journal of Engineering Education

- International Journal of Technology and Design Education
- Journal of Computer Assisted Learning
- Innovative Higher Education
- Expert Systems with Applications
- Education and Information Technologies

**Class Schedule:**

**Wednesday (09.00-15.00) Smart Classroom**

(Online learning is also available for oversea students and in any circumstances face-to-face meeting are not possible);

**Online:** WebEx Meeting

- Meeting link:  
<https://mahidol.webex.com/mahidol/j.php?MTID=m0f2a23c01ced33d5c3e6c50e72e6dae4>
- Meeting number: 2642 330 6985
- Password: ILSE
- Host key: 897592

Week	Date	Topic	CLO	Teaching approach	2022
1*	11 Jan 2023	Introduction to course Introduction to innovations in science, mathematics, and technology educations	1, 6, 7	Lecture; Discussion	PJ, SY (All staff)
2*	18 Jan 2023	Searching and analyzing previous research on innovations in science, mathematics, and technology educations	1, 5	Lecture; Discussion; Case study	PL, PJ SY, SN
3*	25 Jan 2023	<i>Students presentation:</i> Lesson learned from prior work <i>After Action Review</i>	1, 5	Lecture; Discussion	All staff
4*	1 Feb 2023	<i>Students presentation:</i> Emerging idea in educational innovation– <i>Coaching &amp; Mentoring</i>	1, 2, 3, 5	Discussion; Coaching & Mentoring	All staff

Week	Date	Topic	CLO	Teaching approach	2022
5	8 Feb 2023	<u>Group meeting</u> Doing a literature review – <i>Coaching &amp; Mentoring</i>	1, 2, 3, 5	Discussion; Coaching & Mentoring	All staff
6	15 Feb 2023	<u>Group meeting</u> Designing an educational innovation – <i>Coaching &amp; Mentoring</i>	1, 2, 3, 5	Discussion; Coaching & Mentoring	All staff
7	22 Feb 2023	<i>Students presentation:</i> Propose an educational innovation <i>After Action Review</i>	2-7	Discussion	All staff
8	1 Mar 2023	Reflections on your project proposal	4, 6, 7	Lecture; Discussion	KB, SY
9	8 Mar 2023	<u>Group meeting</u> Lesson learned & Redesign – <i>Coaching &amp; Mentoring</i>	2-7	Discussion; Coaching & Mentoring	All staff
10	15 Mar 2023	<i>Self-study:</i> Constructing an educational innovation	2-7	-	-
11	22 Mar 2023	<u>Group meeting</u> R&D the educational innovation – <i>Coaching &amp; Mentoring</i>	2,-7	Discussion; Coaching & Mentoring	All staff
12	29 Mar 2023	<i>Students presentation:</i> Work progression <i>After Action Review</i>	2-7	Discussion	All staff
13	5 Apr 2023	- How to write a summary of project ( <i>Submit 3 days before selling the products</i> ) - How to sell the product	1-8	Lecture; Discussion; Case study	NS, PJ, SY
14	19 Apr 2023	<u>Group meeting</u> Getting feedback on a summary of project & Preparing to sell the product – <i>Coaching &amp; Mentoring</i>	2-7	Discussion; Coaching & Mentoring	All staff

<b>Week</b>	<b>Date</b>	<b>Topic</b>	<b>CLO</b>	<b>Teaching approach</b>	<b>2022</b>
15	26 Apr 2023	<i>Exhibition: Selling the product</i> <i>After Action Review</i>	2-7	Discussion	All staff

\* Weeks 1-4 online class

## **Class Attendance (10%) and Participation (10%) –(CLO 8)**

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

## **Course Assignments**

### **❖ *Assignment 1: Analyze the short coming research or practice (5%) – WEEK 2-3 –(CLO 1, 5)***

You are required to read and analyze previous research on innovation in science, mathematics, and technology education to understand the process on developing the particular innovation. You are required to a 15-min presentation of what you have learnt as well as an idea to make it better on week 3. The presentation should cover the following topics;

- Why was it developed?
- Why the researcher(s) selected a particular type of innovation?
- What was knowledge/information that researcher(s) needed to know before developing it?
- Research process?
- Is there evidence that shows the quality of the developed innovation? Explain

### **❖ *Assignment 2: Propose the idea for development of an educational innovation (15%) – WEEK 4-7 – (CLO 1, 2, 3, 5)***

Each student is required to develop a proposal on the development of an educational innovation in science, mathematics, or technology education and perform a 15-min presentation on week 7.

### **❖ *Assignment 3: Critical reflections on the proposed project proposal (5%) – WEEK 8 –(CLO 4, 6, 5)***

You are required to re-think about your proposed project proposal. You need to criticize the gap and or weakness of your work and also provide idea of how you will solve that problems.

### **❖ *Assignment 4 Develop an educational innovation (55%) – WEEK 9-14 –(CLO 2-7)***

Each student is required to develop the innovation as proposed.

## **Note:**

- (1) The student will have group meeting with IL instructors for consulting.
- (2) The budget will be given upon passing the proposal (1,000 baht each)
- (3) The student will have a 15-min presentation of work progression on week 12 (15%)
- (4) The student is required to write a summary (~2,500 words) of the developed innovation (20%) and then submit to course coordinator at least 3 days before the selling the product
- (5) The students will sell the developed innovation on weeks 15 (All styles are welcome!) (20%)

## Assessments

Class attendance	10 %	
Active participation in class	10%	
Analyze the short coming research	5%	<i>Assignment 1</i>
Proposal on development of an educational innovation	15%	<i>Assignment 2</i>
Critical reflections on the proposed project proposal	5%	<i>Assignment 3</i>
Present work progression	15%	} <i>Assignment 4</i>
Present the final work (Selling the product)	20%	
Write a summary of the developed innovation	20%	

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

$\geq 90-100\%$	=	A
$\geq 80-89\%$	=	B+
$\geq 70-79\%$	=	B
$\geq 60-69\%$	=	C+
$\geq 50-59\%$	=	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 high 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 has to be included in this evaluation

**Evaluation Sheet for Assignment 1 Analysis of Previous Research**

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Evaluated by.....

<b>Criteria</b>	<b>Name of Student</b>
Show the history of the development of innovations in the chosen topic (5 scores)	
Critically analyze strengths and weaknesses of the existing innovations (5 scores)	
Ability to propose new, better way (possible INNOVATION) in the chosen topic (5 scores)	
Ability to clarify ideas through Q&A (3 scores)	
Time management (2 scores)	
<b>Total (20 scores)</b>	



**Evaluation Sheet for Assignment 2: Propose an Educational Innovation**

ILSE659 Innovations in Science and Technology Education for Improve Learning (Ph.D.)

Evaluator:.....

<b>Criteria</b>	<b>Name of Student</b>
Critically analyze literature to find the GAPS e.g. Strengths and Weaknesses of the existing innovations (5 scores)	
Ability to propose educational INNOVATION (New & Better & more Useful ways or things) of the chosen topic (5 scores)	
Ability to support the proposed educational INNOVATION with strong, valid and reliable evidence (5 scores)	
The degree of innovative ideas in the proposed educational INNOVATION (e.g. ranged from very similar to the existed innovation to Totally new) (5 scores)	
Ability to clarify and argue his/her proposed educational innovation through argumentation-based Q&A (5 scores)	
Ability of visual aids and/or media used to help the presentation be more supported and powerful (3 scores)	
Effective time management (2 scores)	
<b>Total (30 scores)</b>	

**Evaluation Sheet for Assignment 4: Presentation of Work Progression**

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Evaluator: .....

<b>Criteria</b>	<b>Name of Student</b>
Critically analyze literature to find the GAPS e.g. Strengths and Weaknesses of the existing innovations (5 scores)	
Ability to improve the proposed educational INNOVATION (New & Better & More Useful ways or things) comparing to the previous version (5 scores)	
Ability to support the proposed educational INNOVATION with strong, valid and reliable evidence (5 scores)	
The degree of innovative ideas in the proposed educational INNOVATION (e.g. ranged from Very similar to the existed innovation to Totally new) (5 scores)	
Ability to clarify and argue his/her proposed educational innovation through argumentation-based Q&A (5 scores)	
Ability of visual aids and/or media used to help the presentation be more supported and powerful (3 scores)	
Effective time management (2 scores)	
<b>Total (30 scores)</b>	

### Evaluation Sheet for Assignment 4: Final Presentation of Innovation

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Evaluator: .....

Criteria	Name of Student
<b>Gap Analysis</b> (5 scores): Critically review gaps of literature (focus on weaknesses of existing innovation)	
<b>From the Start to the End</b> (10 scores) <ul style="list-style-type: none"> <li>o Present PREVIOUS versions) and their improvement</li> <li>o Present the CURRENT VERSION</li> <li>o Show the EFFECTIVENESS of innovation through empirical evidence (e.g. result from try-out, the result of new lab, etc.)</li> </ul>	
<b>Ability to Sell</b> (5 scores): Persuade the audience to buy or use his/her innovation (e.g. interesting, understandable, efficient, impact newer, better, safer, cheaper, etc.)	
<b>Contribution</b> (5 scores): Identify the CONTRIBUTION of innovation to the related field	
<b>Further Improvement</b> (5 scores): State how to IMPROVE innovation in the future	
<b>Originality</b> (5 scores): The degree of innovative ideas in innovation (e.g. Old-fashion□□ Totally new)	
<b>Clarification</b> (3 scores): Ability to clarify innovative thoughts	
<b>Visual Aids/ Media</b> (1 score): Ability to use visual aids/ media to help the presentation	
<b>Time management</b> (1 score): Finish the presentation within time	
<b>Total (40 scores)</b>	

**Evaluation Sheet for Assignment 4: Summary Report of the Developed Innovation**

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Evaluator: .....

<b>Criteria</b>	<b>Name of Student</b>
<p><b>Introduction (5 points)</b></p> <p>Determine a brief background and rationale of the work (innovation). Include the significance or contribution of innovation to the field into the report. Also, define the purpose of the work clearly.</p>	
<p><b>Literature Review (5 points)</b></p> <p>Carefully compare the current work (the developed innovation) to the previous studies. Or clearly state the key improvement to other publications. Key publication(s) has been cited.</p>	
<p><b>Theoretical Framework (5 points)</b></p> <p>Show key theoretical background appropriately to the development of the work (innovation)</p>	
<p><b>Product (5 points)</b></p> <p>Provide a concise and precise description of the work (innovation). Also include instruction to use or to learn the concept from the work (innovation). Clearly explain the ways to learn to the concept and purpose(s).</p>	
<p><b>Evaluation (5 points)</b></p> <p>Determine ways to evaluate the work (innovation). Show the results from the prototype tryout with peers.</p>	
<p><b>Further Improvement (5 points)</b></p> <p>Determine suggestions to improve the work (innovation) based on prototype tryout data.</p>	
<b>Total (30 scores)</b>	