

**EASTEM**

EURO-ASIA COLLABORATION FOR ENHANCING STEM EDUCATION

# How to give and evaluate a ToT course

Joint document developed by EASTEM WP 2 teams in Chiang Mai 12-14 February 2020

## A. How to give a ToT course

### 1. Introduction

In response to the digital era, the goal of education is based on the ability to use knowledge in the growing technologies of the digital economy. The challenge of teaching and learning style is not entirely based on content; moreover, its emphasis will be on how the learners learn to manage and integrate knowledge into skills required in the real world and learn to self-develop their life-long learning skills. According to the necessity of the 21st-century skills of learners in the knowledge-based economy, learners need to know and understand their competence. 21st-century education is different from traditional education in a variety of ways, including an integrated curriculum, student-centered, active learning, self-placed, outcome based, and subjects connecting interests and the real world. Lecturers should know and understand all of the students before bringing them to the learning process. When learners know and understand the advantages and limitations of their performance, they can simplify learning processes and teaching activities.

Encouraging colleagues to adopt similar 21st-century approaches requires not only active role modeling but also support, guidance, and evidence-based evaluation. We have engaged in all of these approaches, and we find that they are all useful at various points. Some colleagues are anxious that the performance of their students will suffer and need reassurance that the opposite is usually true. Gradually, the teachers will help learners to obtain knowledge and skills; and subsequently the course will engage the learners throughout the teaching and learning methods.

One thing is clear; that students develop knowledge through a range of processes, including through experiences and teaching. Through the transformation of knowledge, students learn how to relate information, solve problems, and develop creative and critical thinking. The development of tacit knowledge through experience during higher education is valuable for the next generation of learners. In the learning process, the development of such knowledge has both positive and negative impacts, all of which affect the development of the student as a receiver of information, such as feeling, emotional, thinking processes, skills, etc.

On the other hand, teaching is the process of transforming knowledge accumulated by previous generations for the next generation. Therefore, the majority of teaching and learning by using STEM based approaches is to inspire novice lecturers to align teaching styles for the sake of future learner's best success. Ultimately, the suggested approach can foster better knowledge transfer and improve lectures. The major key of this project can directly influence strategies that can facilitate and enhance learning activities of STEM education.

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## 2. Motivation - rationale

Students are one of the three groups who directly benefit from implementing Student Centered Learning (SCL) in classrooms. There is a variety of beneficial aspects. First, SCL increases cooperation between students, with teachers/lecturers as facilitators. Teachers are able to discuss their research and hear the students' views on the matter, further developing a course and encouraging students to enter the academic community as members. Second, SCL encourages deeper learning through variation of learning techniques such as reading, audiovisual, demonstration, discussion, and practical doing. Students are often more motivated to learn through active learning and they can retain more of the information they learn. Third, students must engage with the course material and have control of their learning. They can gain other skills such as teamwork, communication, prioritization, etc. Students acquire these skills during their study in higher education settings, with benefits for life after college. Lastly, students have different needs and SCL allows students to study in a flexible manner. The approach can be easily adapted to part-time study, distance learning and e-learning. The variety of materials allows students to find the unique, independent learning style that suits each individual.

SCL shifts the role of teachers from being an instructor to a facilitator. Students are the centre of their own learning, increasing motivation and engagement with the learning process. Teachers have the opportunity to review and improve teaching methodologies so that they can always improve themselves through relevant and constructive feedback. When implemented properly, SCL provides opportunities to tackle problems in teaching (high workload for teaching staff, massification of higher education, etc.). SCL may provide opportunities in new research and professional development to the development of knowledge, skills, and competences relevant to personal and career advancement.

SCL produces benefits and outcomes in the quality of education. The quality enhancement happened when the students and teacher "work together" in the SCL environment. The quality of the learning materials, methods, tools, and discussion can happen in the iterative ways. Teaching profession can be improved, when SCL gives opportunities for innovation and allows teachers to develop their own ways of teaching, and students gave flexibility to develop their own tracks. SCL needs cooperation among all levels in the institutions. It will give the way for institutions to collaborate, and strengthen their role. Better retention rate in higher education can be reached when students engage with their studies and understand the value of learning. SCL will facilitate the students more attracting with the activities, fulfill their own expectations in studies, and be more mobile in learning activities. SCL produces the graduates that have capabilities in problem solving, critical thinking, and analytical that will be used for lifelong learning when they are citizens. They have more lessons learnt by themselves, more practical and logical, able to solve the problem especially when they are professional and workers. The students with SCL, will graduate that are effective in their place of work and contribute to society.

From the ToT course, teachers will gain knowledge and experience on various techniques of SCL, how to implement them in their classrooms, and how to assess the students' achievements. Teachers can enhance the quality of the design, management, delivery and evaluation of the courses, and additionally share their experiences to learn from one another through the ToT course.

### 3. For whom?

The ToT course targets a group of 30 experienced teachers/lecturers to be the seeding persons for spreading STEM education (3 per initial 10 universities).

#### **University lecturers:**

Selection criteria for trainees:

- At least five years experience in teaching at higher education level.
- Certified pedagogic skills in SCL, PBL, active learning, blended learning.
- Have experience in working with the industry and/or community service projects.

#### **Highschool teachers (K12):**

Selection criteria for trainees:

- At least five years experience in teaching at higher education level.
- Had higher education certified pedagogic skills in SCL, PBL, active learning, blended learning.

This group of trainers should be experienced and open-minded lecturers able to cope with a wide variety of attendants from different backgrounds, years of experience, learning styles, and expertise. The learners can change the delivery of STEM courses to enhance essential skills and STEM cognition to meet the realistic needs from society and industry, increasing employability rate.

### 4. Overall structure

Note: we should not give certain suggestions, but help the reader to reason by, for example, giving arguments for and against different structures.

To encourage and enhance learning management for teachers using integrated STEM pedagogical techniques the framework should be held on (1) Modules / Special Topics / Course Design /Redesign, (2) Assessment Methods, (3) Outcome of each module, (4) Procedures / Course logistics, and (5) Specific for Home University (Optional)

#### **Example ToT course:**

Course Title	Student-Centered Learning Training of Trainer
Course overview	In this course, participants transform their lectures that have not been implemented with SCL (contents deliver in classical way) into SCL (activity-based). Participants will be guided by a group of mentors with different domain knowledge, including pedagogy area.
Course objectives	<ol style="list-style-type: none"><li>1. To introduce STEM Education and SCL concepts, principles and methods: why, what, how</li><li>2. To design a student-centered learning program of existing courses that has not been run in SCL way.</li><li>3. To gain reflection about the transformation</li></ol>
Expected Outcomes	<ol style="list-style-type: none"><li>1. To engage teacher in professional development building STEM knowledge and practices to enhance integrated STEM approach</li></ol>

Target Participants	Lecturers in University, 20-30 participants in each class
Instructors	[Lectures/Expert/Practitioner]
Unit / Location	STEM center
Prerequisite	The participants must read the reference book and bring course syllabus & original lesson plan.
SCL Framework elements	(1) Course content & SCL process, (2) Design; (3) Implementation; (4) Reflection and conclusion
Procedures / Timeline	(1) 1.5-2 days of ToT, covering two topics: (1) Introduction, Why SCL, SCL concepts, principles and approaches/methods, (2) hands on, case study and design for implementing/applying SCL in the class (2) 1-2 month of implementing the approaches in the class, collecting feedback and comments from lecturers (ToT Participants) and students (3) 0.5-1 days of Reflection, Evaluation and Conclusion
Assessment	Course satisfaction (with rubrics)
Feedback	- Survey - Participants reactions during workshop - Reflection feedback from participants
Outputs	- Class materials - Lesson plans - Brief Report (handout/posters/short video/...)
Reference	(1) Student-centered learning: toolkit for student, staff and higher education institutions. (2010). European Students' Union (ESU) and Education International (EI). Lifelong Learning Program. (2) ...

## 5. Content of the course

Do not limit specific “teaching methods” to be part of the course - this has to vary from one partner to another. Instead, focus on the things that must be there (as for example motivation and independent work by the participants). Provide examples of methods (as flipped classroom).

### Possible Topics for the modules

Each ToT can pick and choose 2-4 of the following topics to fit a 2-day ToT course.

Topic	Purpose	Use cases	Duration
Introduction to STEM education (concepts, traits, models of STEM, Design Thinking in STEM)	Provide learners with understandings in STEM concepts, traits, models, procedures for STEM implementation in class	<b>Discussion</b> STEM concept after watching an overview video clip about STEM education. <b>Group discussion</b> STEM traits, models, procedures	2 hours

Possible STEM topics for teaching activities	Identify possible STEM topics for HE in particular majors/backgrounds	<b>Group work:</b> Identifying STEM topic in professional diversified groups	1 hour
Core competences integrated in STEM education	Provide learners with a vast spectrum of core competences integrated in STEM education	<b>Brainstorming:</b> Determine STEM core competencies in professional diversified groups	30 mins
Teaching and learning approaches in STEM education	Equip learners with teaching and learning approaches in STEM education: +Action-oriented teaching +Competence-based teaching +Service learning	<b>Discussion</b> processes of organizing Teaching and learning approaches in STEM education	2 hours
Assessment in STEM education	Provides learners with assessment methods and tools in STEM education	<b>Socratic dialogue</b> about assessment methods and tools in STEM education Design of assessment tools in STEM education: Checklist and Rubric	2 hours
Practice Organizing and Assessing in STEM education	Provides learners with opportunities to practice teaching strategies and assessment in real-life STEM topics	<b>Group work:</b> Design and organize STEM topic in in professional diversified groups	Homework in 1 week and presentation in 1 day..

Additional module topics:

- Integrated STEM Education approaches and growth mindset
- Design learning and teaching lesson plans based on STEM education
- Media & Innovation for a STEM classroom, Technology-integrated methods
- Best practices and case studies on STEM-implemented courses
- Introduction to SCL Concepts, Principles, and Methods
- Assessment strategies for an SCL class
- Conducting and Implementing an SCL Classroom into Your Course
- Support system (learning environment, tools, resources) available for lecturers.

## 6. Overall comments (Course engagement)

Management of ToT Courses must be open and transparent. It is important to create trust in the process, especially when we have obstacles in the mindset of organizations, teachers and students since the traditional teacher centered learning is still deeply rooted in

many universities. The ToT course needs strategies on how to change this mindset. The ToT course strategies may be started from the of analysis of the existing organization problem for SCL implementation: Identify roles for different actors that will involve in the SCL, identify drivers for change, identify strategies to overcome barriers to change, implement the change (SCL), and evaluate the impact of the change. Several simple approaches for these are giving the teachers and students transparency and consultancy for supporting the process. Teachers and students have the opportunities to consult the outcomes, quality assurances, and reports.

SCL approach should be tailored to the individual classroom. This is because each classroom may have different needs and teachers should have open minded especially to have open sessions to hear feedback from students. It is possible that students will not be familiar with the SCL may not understand how SCL could help their learning. Teachers may have to summarize key concepts of activities and allow students to reflect their thoughts on the new learning method. In order to help teachers to understand this process, ToT should provide examples of methods for students to provide feedback on their thoughts and their role in SCL such as self-evaluation, peer evaluation, and class assessment. Teachers can provide clear evaluation schemes so that students know what the key performance indicators for evaluations. ToT courses could provide a variety of evaluation methods so that teachers could choose what is right for their class.

After the completion of the course, participants should keep in touch with each other in order to share experiences and gain new ideas on the implementation of SCL in their classrooms. STEM centres can provide physical places in which teachers can gather and discuss things with each other or with some experts. Even a simple chat group in which the participants gather online may serve as a tool for such discussions to happen. This can provide improvements and sustainability for implementing SCL in the education process.

ToT courses will provide

- Web page for publication consist of ToT description, course objectives, outcomes, schedule, instructor and collaborators
- Learning path/route to give the participant guidance
- Learning/content management system to provide the materials can be accessed anytime online
- Chat or helpdesk facilities to grab the issues from participants
- ToT Documentation (infographic, video, image, etc)
- Social media links to share the activities
- Successful case for example STEM learning
- ToT Course Assessment

## **B. How a partner could evaluate its course**

### **1. What quantitative data can be collected and analysed?**

- Number of STEM courses conducted in STEM learning approach
- Number of teachers trained
- Number of ToT training courses / Modules (in home university)
- Number of courses for student development
- Number of students in the class applying SCL approach

- How many hours the SCL-based classes are conducted
- STEM graduated (students and employee)
- Grade achievement of student expected abilities
- Rubrics/checklist assessment on trainees' performances in STEM teaching.

## 2. What qualitative data can be collected and analysed?

- Organization strategy statement (i.e Strategic Plan Document, etc)
- ToT course procedures quality (SOP, technical guidelines)
- Teachers and students ready-ness (before ToT)
- Institutional policy and support
- Satisfaction from the ToT course
- Career achievement of the alumni toward the program educational objectives
- Feedback from the industry/employers
- Feedback from STEM approach taught classes
- Teachers and students self evaluation (after ToT)
- Observation and interview of trainee performance after the training.

## 3. How do we know how well we have done?

- Rubrics for evaluation (General and Specific rubrics)
- % of employability raised
- From teachers and students self-evaluation, if mostly give positive feedback/opinions
- Testimony from the participant and students
- Questionnaire for participants, (content, delivery, environment, and infrastructure)
- Feedback from industries

## 4. How do we learn what to improve and in what way to improve?

- qualitative, open-ended questions soliciting feedback from participants
- reviews from participants 6 months to 6 years later (what was helpful in the course)
- Feedback from the trainers
- Feedback from the participants (of ToT) and students (of SCL-based class)
- Formative assessments with analytic/holistic rubrics and feedbacks
- Student Feedbacks from STEM based learning approach in real classroom
- Improvement in ToT course teaching preparation, implementation, and assessment.