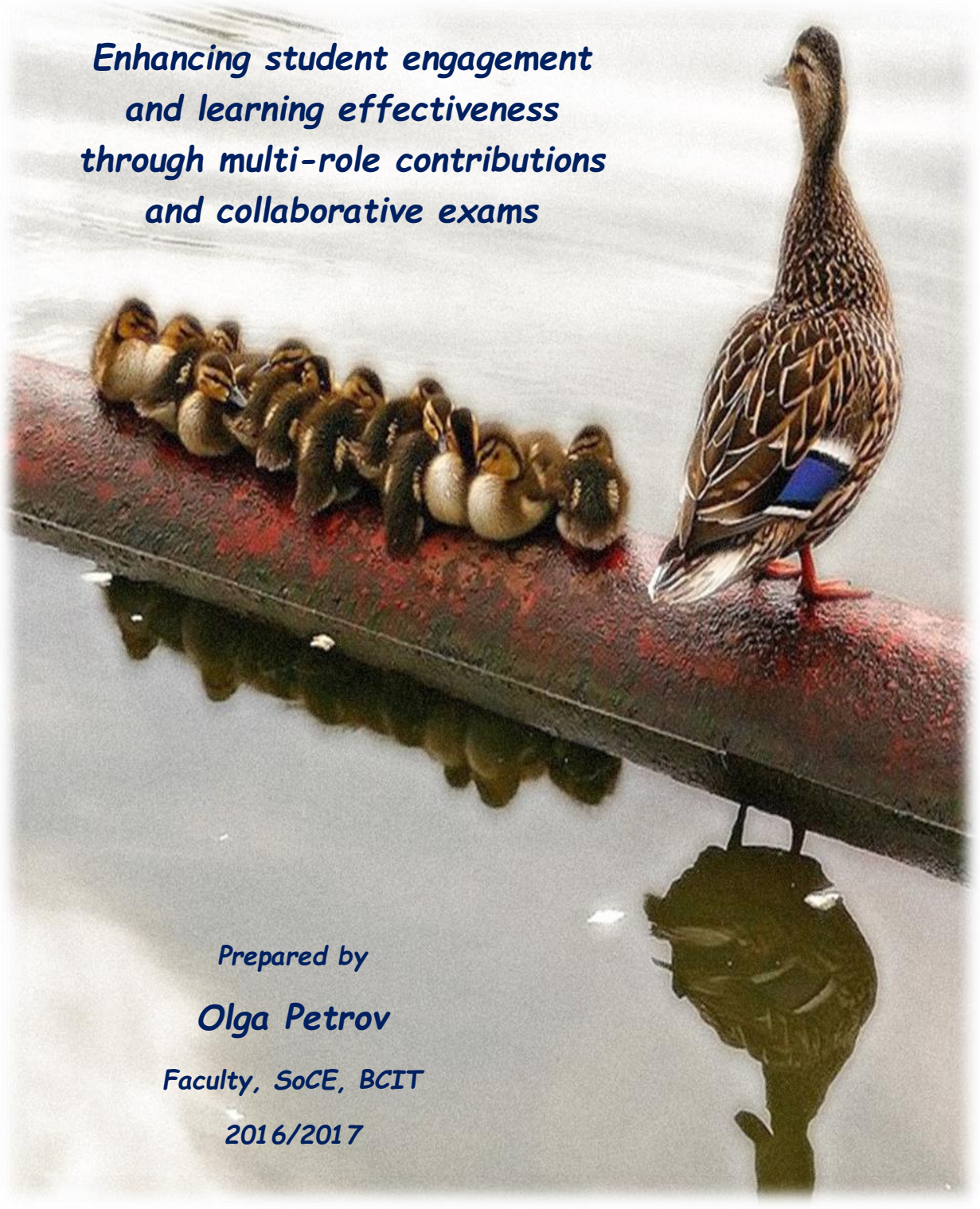
Instructional Enhancement Grant

Final Report



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Introduction

Traditional teaching-learning process involves instructors delivering new material through lectures/labs and students learning the presented material mostly based on lecture notes/slides and some recommended literature. Due to a large number of courses per term (Environmental Engineering students take an average of 7-8 courses per term), students stated that there was not too much time to cover (learn) the presented material thoroughly; even in the case of less courses taken per term, the current practice of having numerous assignments, quizzes and projects per course that instructors introduce to get students to practice through applied learning, may add frustration to learners (students) who struggle to complete all requirements in order to collect grades and successfully complete exams. This practice may present a burden rather than beneficial learning for students as they complete assessment items by numbers and tend to memorize abundant course material for exams.

To the best of my knowledge the proposed way of organizing course through a coupled teaching-learning delivery and especially conducting exams in a collaborative manner has not been practiced before. All current assessment methods included one-way style, ie. Instructors defining assignments, projects, quizzes and the like and students responding to those with little or no say or suggestions (**Figure 1**). In my experience, that created obedience in fulfilling the course requirements (students asking "What do you want us to do for this project/assignment?") rather than designing, suggesting and thoroughly learning with enjoyment and purpose. Evaluation is consequently performed based on how well a student met the assignment requirements rather than on learning outcomes.

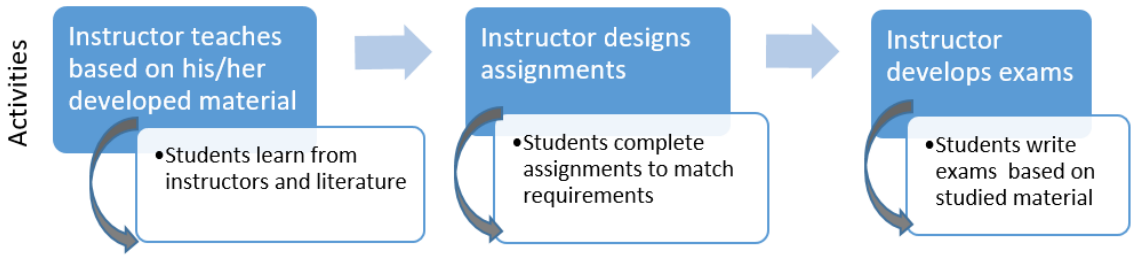

***Figure 1**. Traditional mechanistic teaching and learning activities*

This project proposes teaching-learning coupling as students take different roles during the course, from being learners, teachers, and proponents; finally, students take exams in a collaborative manner – initially, their exam is done individually followed by a team consultation period for the exam completion. Based on a case study, the EENG 8293 Climate, Energy & Carbon Management course, the idea of topic-team-role matrix is designed and presented here to explain how students switch topics and roles in order to cover and learn the whole course material. A sample of a collaborative exam along with a marking scheme (individual + team contribution assessment) is presented.

Part A - Teaching-Learning Coupling

Proposed interactive teaching and learning activities is presented in **Figure 2**. This example considers three topics in a course:

- Topic 1 (here presented as: GHG standards and protocols),
- Topic 2 (here presented as: GHG verification and validation), and
- Topic 3 (here presented as: Carbon credits, taxes and trading systems)

which are supposed to be covered in consecutive weeks 8, 9 and 10 of a 12-week course. The class is split in three teams: A, B and C.

For the class in week 8, Team A will be assigned to teach topic 1. Teaching involves deep studying of the topic, collecting appropriate literature, synthesizing information, preparing slides, lecture notes and some kind of a class exercise. "Teachers" (team A) have to be prepared to answer any questions the class may have. Class exercises involved quick quizzes, team work on an assigned question from teachers etc. During that class other two teams B and C are taking notes and participate in class activities. They will learn in class and from the assigned reading material and lecture notes.

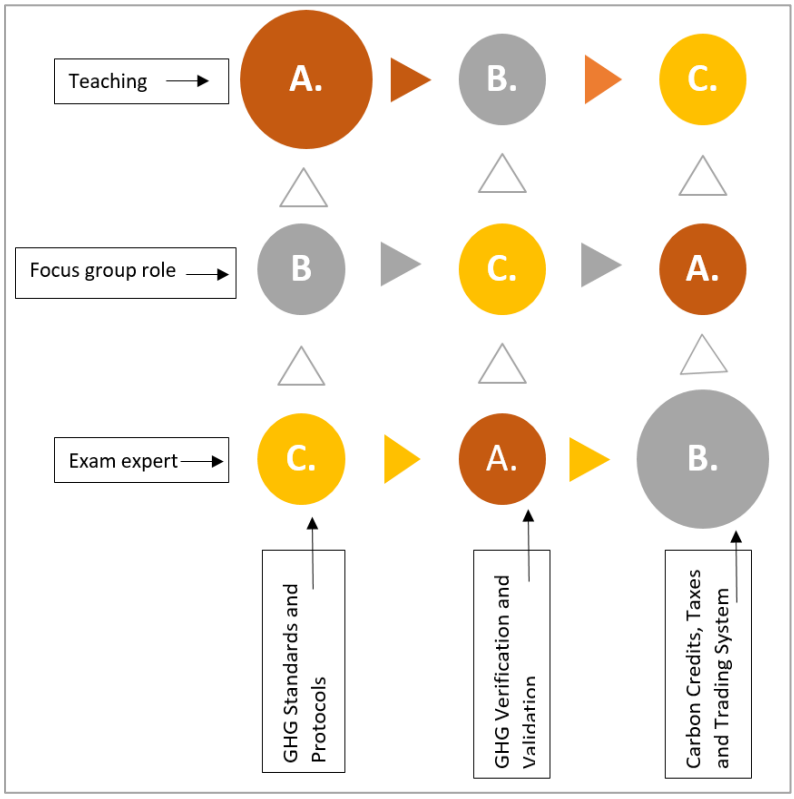

Figure 2. *Proposed interactive teaching and learning activities matrix*

In Week 9, Team B will be assigned to teach topic 2. The same responsibility and preparation, class quality and activities is expected. Other two teams (A and C) are learners this week.

In Week 10, Team C will be assigned to teach topic 3. Other two teams (A and B) are learners.

Once the teaching task is completed with all three topics covered, the second round of task considers the same three topics but with a different learning style and swapped topics among teams so to give each of them the opportunity of learning the same material in a different way, ie. using different learning technique. While sitting in class and listening to other people teaching (either instructor or classmates) could be mostly a passive process regardless class activities, using a different learning technique will enable learners to review the topic in a more thorough way.

The second activity involves the Focus Group exercise as presented in detail in **PART C** of this document (Focus Group role play) to be carried out in Week 11 of the course. This exercise requires in depth preparation for the assigned role as the topic for each group will not be the same as they had for a teaching role. For example, Team A taught topic 1 but for the Focus Group role play they will be assigned topic 3. Similarly, Team B taught topic 2 but for the Focus Group role play they will be assigned topic 1 while Team C will be assigned topic 2 for the Focus Group role play as they taught topic 3. Each team is aware that at their Focus Group table they will have at least one quite knowledgeable opponent (the one who previously taught that topic) and in order to win the argument they need to be well prepared. Learners prepare for their roles through studying and on-line team discussions, they develop a strategy through team work and write a 2-page document which is later marked as an assignment for that course.

Once in class, a number of different Focus Groups (tables) are organized, each with 3 members, representatives of each team (with different topics, so a member with topic 1, a member with topic 2 and a member with topic 3). For example, if each team had 5 members, then 5 tables ie. Focus Groups will be established with 3 members each. Their discussion is interactive and they are supposed to reach consensus. As presented in **PART C**, each team was given some directions but it will depend on their own team work how well they will be prepared and handle the Focus Group discussion. It should be noted that the results are always quite interesting as the solutions and justification from each Focus Group could be slightly different although strategies for each team were the same and presented equally by each member at their respective tables – such different outcomes also teach the class how some solutions may differ depending on the players in negotiations. This exercise strengthen critical thinking and communication skills.

Part B - Collaborative exams

The final exam is the final step in this proposed learning matrix. It is up to an instructor to decide if the final is cumulative, ie. covering the whole course material or only the material after the midterm. Taking into consideration the learning model presented here, learners will all have a number of the identical questions from the most of the course material but not from the portion of the material covered by this learning matrix (three topics covered in a different way).

Here, I presented the final exam which is not a cumulative one, however, material covered on energy systems, GHG inventories and LCA will be required from all students to be studied for the final. In addition they will study in depth only one of the three topics covered by the teaching-learning coupling method presented in this document. This saves some time for studying again the material on two topics they extensively covered already (through teaching and the role play roles), while spending more time on the third topic and the rest of the course material required for the final exam. This approach also reduces anxiety as leaners are aware that they have less material to review and consequently more time to study.

A sample of the EENG 8293 exam for Team A is presented in **PART C** (part III). The first three questions (1.1, 1.2, and 1.3) are identical as for Team B (2.1, 2.2 and 2.3) and Team C (3.1, 3.2 and 3.3) whereas the remaining three questions are team- and topic-based:

- Team A questions 1.4., 1.5, and 1.6 are on topic 2 (since they taught topic 1 and role played on topic 3),
- Team B questions 2.4, 2.5 and 2.6 are on topic 3 (since they taught topic 2 and role played on topic 1),
- Team C questions 3.4, 3.5, and 3.6 are on topic 1 (since they taught topic 3 and role played topic 2).

Students are allowed 60 minutes for individual work on their exams; after that they can spend a 30-min period with their team and help each other with any exam question. Although contribution in grades is minimal (6 points total), it is significant in terms of students' confidence - even if not exactly sure about some answers, he/she could be helped. The exam itself is here also considered as a learning opportunity. Maximum exam points are set to be based on an individual work (in this case 60 marks) and additional marks are given for team contribution. This marking scheme ensures that students can at a minimum obtain the grade they deserved by their own work (what is the case of a traditional exams) and additional team work can only boost their grade but cannot damage it if other team members are not prepared for the exam and do not contribute during the team-work portion of the exam. Learners (students) also feel responsibility to help other team members if they have been helped so learning becomes a shared responsibility!

This mode of exams was carried out for a couple of years in the EENG 8293 and showed excellent results. Learners (students) feel much better knowing that they are getting help with course material, time for preparation, and exams. And…..it is so much fun! Sometimes some topics are dry and it is very difficult to keep class attention so this model enables that at least some portion of a course introduces a bit more dynamics and an interactive work.

Part C - Application of the proposed method: EENG 8293 Climate, Energy & Carbon Management

The following pages are samples of the Focus Group role play design and agenda. A sample of the final exam for one team is also presented.

Samples of course activities and the final exam

EENG 8293: Climate, Energy & Carbon Management

Part I – your lecture delivery on March 14, 2016; slides due by 2:30pm to dropbox

Part II – Focus group role play summary due March 24, 2016 by 11:30 pm to dropbox

PART III - Final exam on March 24, 2016 (60 min individual + 30 min team)

Part I

Teaching

Each team will prepare a 30 – 40 min lecture on an assigned topic outlined below – you need to *teach* the class on that topic so in addition to delivering a lecture, think about a small class activity to engage the class. You will teach your lecture on assigned date (TBA for each team)
Your lecture will be delivered using a power point presentation, please provide a title slide with all details, and a list of references on the very last slide.
[Please note that these lecture topics are different than your stakeholder topics although the team members are all the time the same!]

Topics:

1) **GHG Standards and Protocols** (please include the Paris Agreement);
   Team A: Mustafa, Michael, Kris, Anna and Alex J

2) **GHG Verification and Validation**
   Team B: Leah, Liz, Brandon and Brad

3) **Carbon Credits, Taxes and Trading System**
   Team C: Victor, Kalie, Alex F. and Ai Nie

Part II

Focus group role play

BC Ministry of Environment and BC Premier agreed on investing $50,000,000 in managing GHG in the province of British Columbia. Faced with many challenges associated with supporting provinces economy by developing LNG plants and pipelines on one hand and supporting renewable energy to replace fossil fuels on another hand, they invited three consulting groups with experts in areas they believe will be a priority for investments in GHG management. These groups are:

Team A: CAMPOS - Provides for investing in evaluation and continuation of carbon tax and cap & trading system

Team B: INVENTOS - Provides for investing in protocols such as comprehensive GHG inventories

Team C: VALIDATOS - Provides for investing in GHG validation/verification

A consultation (focus group) meeting is scheduled for ***Thursday, March 17, 2016 at 7 pm at BCIT, SW3-3615****. Each group is requested to come up with a strategy to convince the Ministry and Premier (by winning the argument with other two groups) that their area is the one to be funded. Each group will draft 1 – 2 pages arguments that will emphasize benefits of their proposed investments as well as advantages/priorities over other two areas. For example, group Inventos will come up with arguments which should convince others that priority should be given to the preparation of GHG inventories because a)…..b)…..c)…….reasons, over investing in cap & trade, taxes policies and validation-verification.* ***Each group should keep their arguments and strategy confidential before the meeting and will develop a tactic how to negotiate with other two groups****.*

The consultation session will be facilitated by a representative from the MoE and Olga Petrov, secretary to the BC premier.

The session Agenda:

7:05 pm – 7:10 pm – introductions and session plan discussion
7:10 pm - 7:20 pm – groups will review and confirm their strategy and advise on approaches to win the argument (please note you should come prepared to the class with a written 1 – 2 pages strategy as outlined above)
7:20pm – 8:00 pm consultation session: we will have 4 tables with representatives from each group and you will each present your argument for 5 min and then have discussion trying to reach ***consensus****.*
8:00 pm – 8:15 pm each table members will present their decisions; Q &A period
8:15pm – 8:30 pm break
8:30 pm – 9:00 pm exam discussion.

Note:

- Each group has a restricted discussion area on D2L. Please carry on discussions from now on so to prepare a draft version of your strategy.

- Each team member should have a hard copy of that draft strategy and bring it to class on March 17, 2016; you will be assigned to negotiating groups but should follow your team's strategy as you agreed upon (while preparing this assignment)
- You will have the opportunity to improve your strategy after the focus group play when some questions will be answered and points clarified, so you are expected to submit your final version of the strategy Part II) by March 24, 2016, by 11:30pm to designated dropbox.
- Please clearly name your file by the group name and FINAL version.

Don't forget to have fun! Learning is more beneficial in relaxed environments ☺

Part III

Final exam sample

British Columbia Institute of Technology

Climate, Energy & Carbon Management

EENG 8293

Final Exam

Thursday, March 24, 2016

Instructor: Olga Petrov

TEAM A: Mustaffa Hamad, Michael Kwong Chi Chan, Kristofer Cheater, Anna Premia, Alexander Jardine

Student Name (please PRINT) _____

Signature: _____

Student number:_____

Total pages of exam: 10

Time allotted: 60 min individual + 30 min team **Total marks: 60**

(60 individual + possible **6** team)

Q 1. SUBJECT: ***GHG Validation/Verification*** *(plus Energy/LCA, GHG inventories)*

Please make sure that your writing is legible.

INDIVIDUAL ANSWERS for QUESTION 1.1 – 1.6 (Each question **10 marks**)

Question 1.1.

What are the main stages of each LCA? List elements/parameters considered in each stage.

Question 1.2.

GHG inventories consider emissions divided in scope 1, 2 and 3. Explain the type of emissions for each scope and provide examples applied to Maxxam laboratories in Burnaby.

Question 1.3.

Energy systems are claimed to have a pivotal role in climate change issues.

a) What are the main building blocks describing energy systems?

b) Which segment of the system you believe would be priority to address in the GHG abatement efforts? Explain!

Question 1.4.

Explain the differences between GHG project validation and verification?

Question 1.5.

What are the key steps for completing a *Reasonable Level of Assurance* during the GHG project verification process? How does it differ from a *Limited Level of Assurance*?

Question 1.6.

Explain the materiality assessment in the GHG project verification.

TEAM CONTRIBUTIONS for QUESTIONS 1.1 – 1.6

6 marks this section; these additional marks (**maximum 6 team marks)** will be added to each student's overall mark.

Please provide your name and question number for each contribution

Q_____ by _____

Q_____ by _____

Q_____ by _____

Q_____ by _____

Q_____ by _____

Q_____ by _____

Similarly, teams B and C will have questions from their respective topics:

Q 2. SUBJECT: ***Carbon Tax, GHG Trading*** *(plus Energy/LCA, GHG inventories)*

Q 3. SUBJECT: ***GHG Standards and Protocols*** *(plus Energy/LCA, GHG inventories)*

Conclusions – expected benefits

This project proposes an innovative approach which includes the following benefits:

- Replacing traditional mechanistic (one-way) course material delivery by instructors with a Socratic Spirit style of learning where students (learners) take an ownership of the content through an active multi-role participation, resulting in a creative and in-depth learning under the instructor's guidance.
- Increase learning effectiveness by constant engagement and iterative multi-model material delivery aimed at in-depth concepts' understanding ("*Repetitio est mater studiorum*").
- Goes a step forward from *the status quo* practice of individually performed exams by adding a collaborative component where during the exam the students get the opportunity of discussing critical questions with their team asking for clarification (what happens in a real-life situation at work) so the exam itself presents a learning experience rather than a stressful one.
- Extension and expansion of knowledge by actively exchanging ideas and learning from each other.
- Increase student responsibility for learning the course material beyond the usual goal "to pass the exam", as they are expected to help other team members while receiving help from others.
- Reduces exam anxiety which is so common during exam periods.
- Develops reasoning, presentation and communication skills.
- Increase instructors' motivation for creative, broad subject discussions and knowledge exchange with students (as oppose to only delivery of knowledge to students).