CRITICAL THINKING PROJECT

8th semester

MISiS

ESP Course Description

English for Science and Technology, an integrated skills course , aims to provide students with the academic and language skills needed for successful study or professional work in a scientific context where English is the working language. The course challenges students to collectively arrive at solutions through *critical and creative thinking* .

Different ways of how Ideas are generated, analyzed, synthesized and expressed promotes the acquisition of general competences vital to 21st century success.

- New Economic School (Skolthech) :

  Sharon Hannigan, Ph.D

  “ A problem-based learning approach to English for science & technology design”

- Adapted to NUST MISiS

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The course consists of 3 modules, each revolving around a "BIG problem" In science and technology …

UNIT 1		**Electric cars**
UNIT 2		**Biocompatible materials**
UNIT 3		**Artificial intelligence**

…expressed in 3 modalities…

- Verbal
- ap

- Visuospatial

Course Overview

- The 8^{th} semester lasts **13 weeks** till the 9^{th} of May.
- **TWO** classes (4 hrs) every week.
- **THREE** Modules (TOPICS) are organized around a current problem topical at MISiS: electric cars; biocompatible materials & artificial intelligence (AI)

Method description

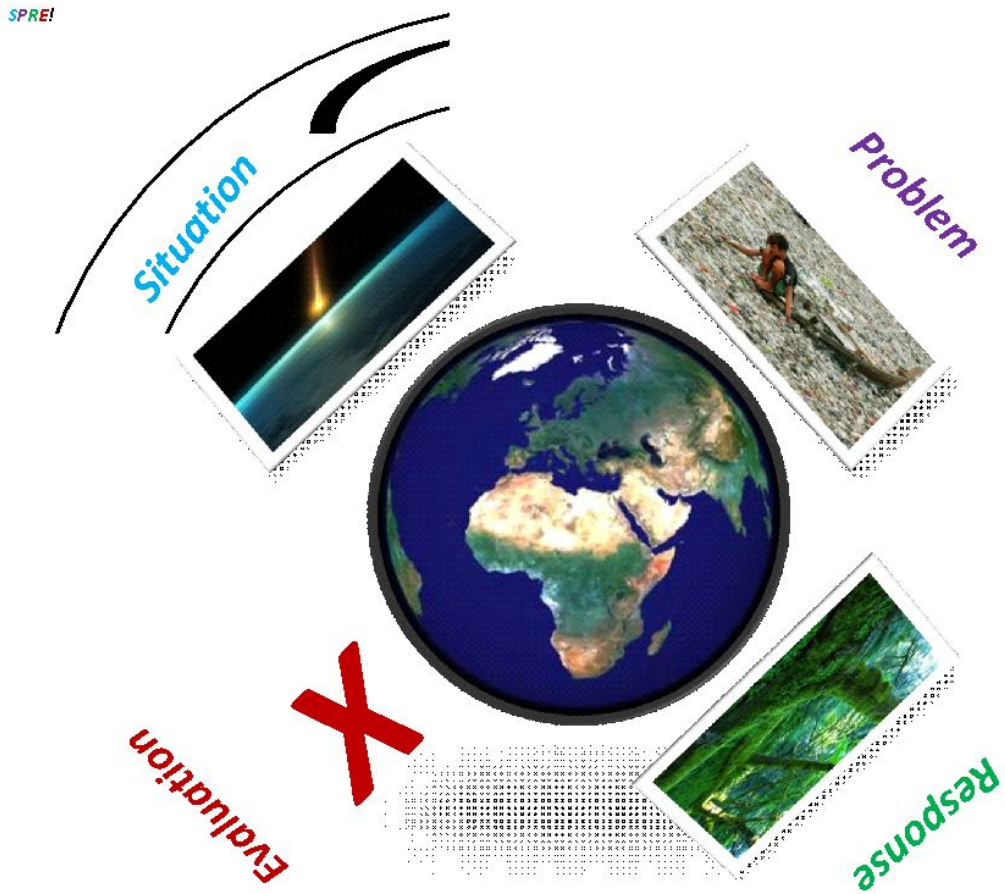
Problem-based learning approach (PBL)

to language learning set into motion by **a critical thinking framework (SPRE).**

SPRE Critical Thinking Framework

1. **All team together** **SITUATION** ***Who? What? When? Where?*** ***Objectively describe or report dilemma***	**Student 1** **PROBLEM (given by a teacher)** ***What's wrong/the matter?*** ***Identify& prioritize problems: 1sr, 2nd)***
Student 2 **RESPONSE** ***Reaction to problem(s)*** ***How do you go about solving the problem? What actions should be taken?***	**Student 3** **EVALUATION** **Overall critical assessment** ***Will our response be effective? What's are its pros/cons, costs/benefits?***

SPRE Framework



Week 1: introduction.
Debates

A teacher has a list of topics for debates:

1. Evolution is a fact.
2. Should Humankind Be Spending Money On Space Exploration?
3. Will the human race survive if a large asteroid does hit Earth?
4. Is human genetic engineering ethical?
5. Will the new 2017 Chevy Bolt position General Motors as serious player in the electric car marketplace?
6. Is Global Warming a man made problem or is it only a natural occurrence?
7. If oil prices continue to fall, will this help the world economy?

8th semester timetable

- Week 1 Introduction
- Weeks 2-4 Unit 1
- Weeks 5-7 Unit 2
- Weeks 8-10 Unit 3
- Week 11 Test
- Week 12-13 Reflection

* Optional: Unit Synthesis Capstone Presentations

Week 1. Introduction.
Subject Quiz

1. Which of the following statements is not true?

A a battery is an electrochemical cell.

B If an electrode acted as the anode during discharge it will act as a cathode during charging.

C During the operation of a battery, one material is oxidised and another is reduced.

D The voltage needed to charge a battery is less than the voltage produced when it is discharged.

2. What batteries might you use to power the following applications?
(a) A mobile phone
(b) A hand-held computer console
(b) A wristwatch
(d) To start a car

UNIT Schedule

Week	Focus	Syllabus
Week 1	A teacher introduces a topic with videos/texts and exercises	Podcasts/Video segments Texts Comprehension, lexical, discourse exercises
Week 2	Setting up a problem. Breaking into teams. Discussions and brainstorming.	Breaking into teams of three (PRE) Setting up a problem Brainstorming Students bring their own materials to class and discuss them Setting up a panel discussion: students determine their roles (PRE) Teacher shows them assessment rubrics
Week 3	**Panel discussion**	Panel discussions happen (3- min speech from each student + 1-2 visuals) All students participate as speakers and audience.
	Writing assignment	Science report : separate assignments for each role. Approach: critical thinking. Format: 2-3 pages (double-spaced) of prose.

8th semester assessment

IELTS (Mark) + Critical thinking project (Pass/Fail)

IELTS RESULTS	Final mark (diploma)
• 5,5-7,5 • Project Pass	excellent
• 5,0 • Project Pass	good
• 4,5 • Project Pass	satisfactory
• 0-4,0* • Project Pass	unsatisfactory * satisfactory if IELTS retake result in May is 4,5+
Failure to complete Project work in the semester downgrades IELTS score to "0".	unsatisfactory

Critical Thinking Project Assessment

(Pass : 7 “v’s” out of 9)

	Individual Completion of Activities	Participation in Panel Discussion	Personalized Report Writing
UNIT 1	“v” =done	“v” =done	“v” =done
UNIT 2	“v” =done	“v” =done	“v” =done
UNIT 3	“v” =done	“v” =done	“v” =done

Course Details

Week1. Class 1.

- A. Introduce module problem: VIDEOS
- Podcasts & video segments (www.ted.com; www.youtube.com; www.bbc.com/news/technology)
- Academic lectures (www.ocw.mit.edu; www.doitpoms.ac.uk)

* *This materials as well as texts will be provided by us at www.dropbox.com (details will be sent to you later)*

Week1. Class 1.

- B. Listening Comprehension (provided by us)
- *NOTE: For all exercises, language is extracted from the audio-visual segments that introduced the module problem.*
- Comprehension:
- Vocabulary:

Week 1. Class 2.

- C. Academic (Science/Engineering Journals
- Reading comprehension exercises (gist/details)
- Academic discourse patterns
- Grammar/vocabulary exercises targeting at structures common for scientific papers

* Texts will also be provided.

The Meteoritical Society

Meteoritics & Planetary Science 45, Nr 10–11, 1553–1556 (2010)
doi: 10.1111/j.1945-5100.2010.01156.x

2008 TC_3: The small asteroid with an impact

The story is now familiar: On October 6, 2008, Richard Kowalski at the Catalina Sky Survey in Arizona spotted a small 3 m sized asteroid, now named 2008 TC_3. It was soon discovered that, 20 h later, this asteroid was to impact Earth. Steve Chesley of NASA/JPL calculated an impact location in the Nubian desert of northern Sudan. In the hours before impact, astronomers measured the light curve of the rare tumbling asteroid and a reflectance spectrum, describing its shape and taxonomic type. This was the first time that an asteroid was studied in space before hitting the Earth.

In the predawn hour of October 7, satellites recorded the fireball west of Station 6, putting the main −20 magnitude detonation at a high 37 km altitude. The impact happened around the time of morning prayer. Thousands along the Nile from Abu Hamed in the south to Wadi Halfa in the north watched the fireball. Some took cellphone images and video of the remaining dust cloud when it was illuminated by the rising Sun. One photo featured later as an Astronomy Picture of the Day (APOD).

And that was not the end of the story. On December of that year, students and staff of the Physics Department and the Faculty of Science at the University of Khartoum, under the guidance of Peter Jenniskens of the SETI Institute and Muawia Shaddad of the University, searched along the predicted trajectory and recovered the first meteorites now called Almahata Sitta (meaning "Station 6"). Most finds were made south of the predicted trajectory, a topic of ongoing investigation. The recovery of fragments from a frail comet-like fireball exploding this high in the atmosphere was unprecedented. The first meteorites found, and the dominant kind recovered, turned out to be polymict (brecciate) ureilites. This was the first recorded fall of a polymict ureilite, and the first time a meteorite was recovered from a known asteroid.

One year after the fall, on December 6–7, 2009, researchers met at the University of Khartoum to discuss the analysis of the asteroid observations, the conditions during the impact, and the study of the recovered meteorites (Figure 1). The results are reported in this special issue of *Meteoritics & Planetary Science*.

THE IMPACT OF 2008 TC_3 ON METEORITICS AND PLANETARY SCIENCE

And what an asteroid it was! The research presented here sheds new light on the smelting process recognized in the ureilites. The cooling rates calculated from the quenching of the smelting implied that a protoplanet broke in 10–100 m sized fragments following a giant collision. Those fragments were later ground down into the tiny pieces found in 2008 TC_3, presumably in subsequent collisions. The final fragments gathered in loosely welded together assemblages of small millimeter and sub-millimeter sized fragments, with much pore space in between. Other fragments of Almahata Sitta were rare lithologies, rich in olivine or pyroxene. In total, 2008 TC_3 contained material that represented all known oxygen isotope variation known from other ureilite finds, possibly because all originated from one original ureilite parent body protoplanet.

In those later collisions and reassemblies into daughter bodies, some nonureilite material became mixed in. Of the recovered Almahata Sitta meteorites, 57.6% are not ureilites at all but meteorites that resemble chondrites. So far, this included meteorites akin to H5 and L4 ordinary chondrites, enstatite chondrites of types EH3, EH4/5, EH5, EH6, EL3/4, EL5/6, and EL6, and a kind of carbonaceous chondrites. The impact explosion appears to have separated nonureilite clasts from the ureilite host material. Numerous arguments are developed in the articles in this special issue that demonstrate that these nonureilites originated in 2008 TC_3 and were not present in the desert before the fall.

These are not your ordinary "ordinary" chondrites, because the centimeter-sized fragments became mixed in with the ureilites long ago. The current population of small asteroid fragments hitting Earth have cosmic ray exposure ages < 100 Myr. Hence, the current population of chondrites originated likely from other sources than the chondrites that were trapped in 2008 TC_3. Instead, those nonureilites may represent material from the impactors that decimated the original ureilite parent body fragments.

- "Text-busting"!
- Scientific structures & discourse patterns!
- Genre-appropriate documentation & formatting!

Week 3.

Panel Discussions (PD)

Week 2. Classes 1-2

- a teacher **sets up a panel discussion. (PD)**
- students reach consensus within their team on their roles by filling out the chart below.

Expert panel members	Problem-solving roles
1. Name	Problem
2. Name	Response
3. Name	Solution

Week 2. Class 1.
Preparation for Panel discussion

A teacher sets up a problem.

(You'll be given 2-3 options to choose from)

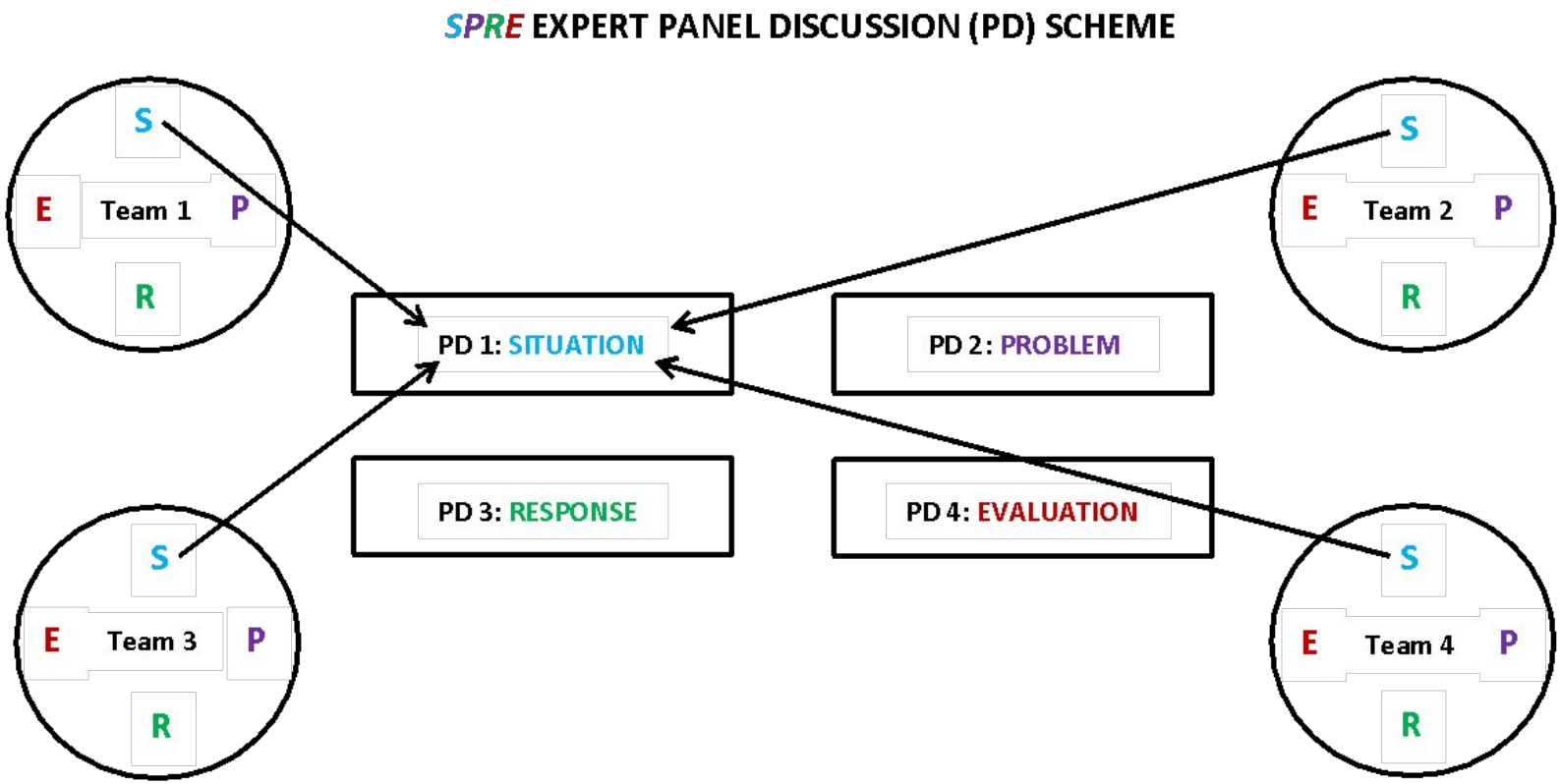
but each study group work on the same problem!

PROBLEM Example from Unit 1.

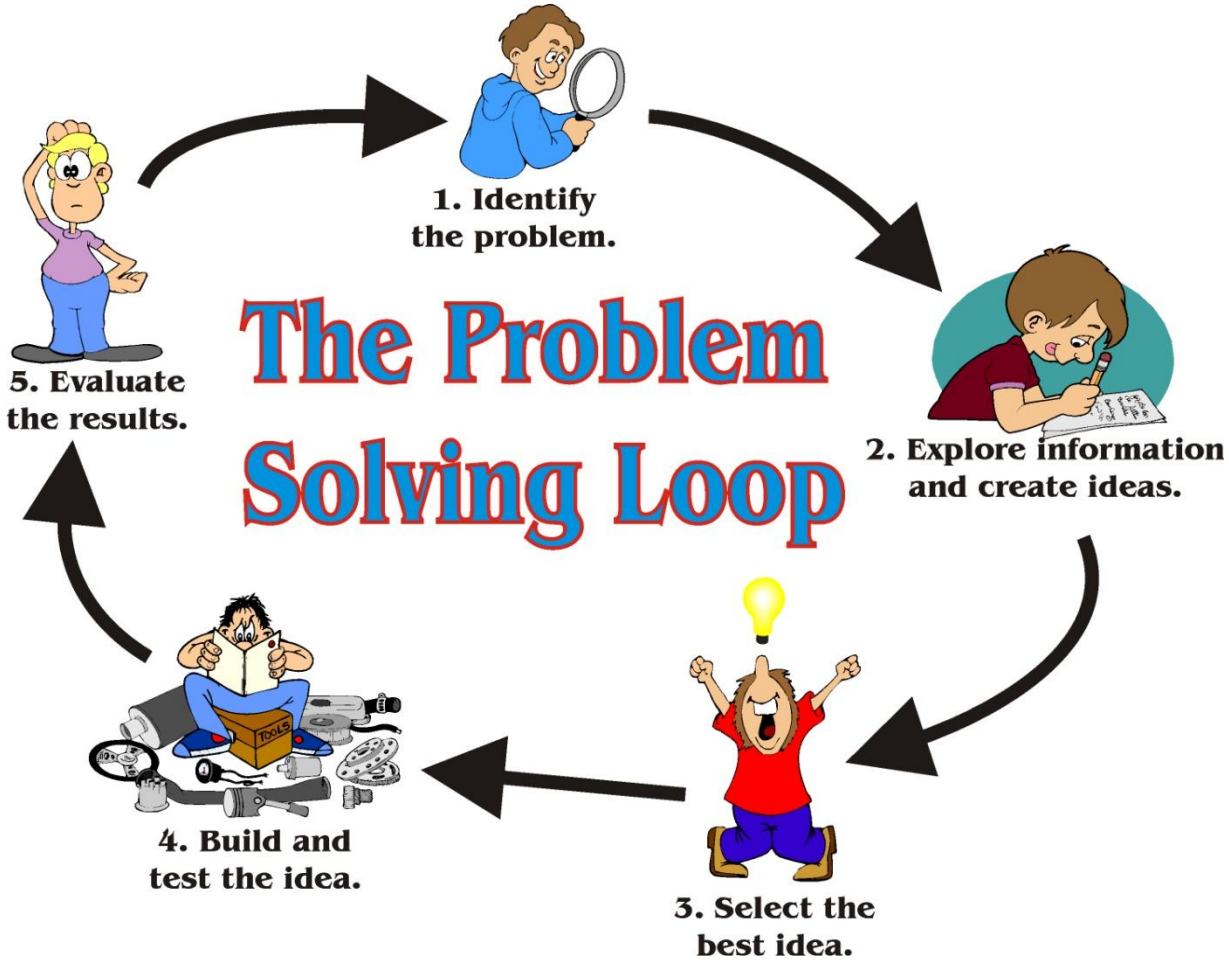
It is common knowledge that the usage of petrol cars causes an irreversible damage to the environment, and the feasible alternative is launching the mass production of electric cars. Car manufacturers offer a reward to those who create a new type of battery which will last longer and cost and weigh less.

Moscow Battery Life Association MBLA need to work out a possible solution to the issue above. The solution should consist of three parts Problem – Response - Evaluation. You will present your solution as experts in the series of panel discussion under the title: Potential increase of the Battery Span 2015

3rd week. Class Panel Discussions



Demo. Panel discussion.



spre rotation

	Module 1	Module 2	Module 3
Student 1	**Problem**	**Response**	**Evaluation**
Student 2	**Evaluation**	**Problem**	**Response**
Student 3	**Response**	**Evaluation**	**Problem**

Week 3. Class 1.

- Three PDs will take place in a succession, with each students speaking for 3 min (time limit strictly enforced).

- The “expert” panels will consist of one member from each PD team as follows:

  1st PD: “Problem” members, only

  2nd PD: “ Response” members, only

  3rd PD: “Evaluation ” members, only

Class Panel Discussions

After all PDs are finished, there will be a 20-minute Q&A period - providing SPRE teams a chance to challenge competing MP solutions while continuing to promote their own.

Teacher roles:

(1) To determine speaking grade for each student, individually, according to a rubric.

(2) To assess audience participation: note-taking, Q&A, comments

Speaking rubric (sample)

Content	5 points	Task response
		Organization
		Visuals
Vocabulary& Grammar	5 points	Grammar
		Vocabulary
Presentation skills	10 points	Generates interest to others
		Preparedness
		Pronunciation
Participation as audience	5 points	Questions & answers
		Comments/timing

Week 3. Class 2.

- B. *SPRE* **writing assignment** (partially done in class)
- Should be a **separate** assignment for each PRE role.
- Should have a format of report with a clear given structure.
- Should be written in prose, be 2 or 3 pages in length double spaced.
- Should include 2 or 3 in-text citations according to Chicago Manual of Style (CMS) convention.
- Should be submitted on the 5th week.
- Should be graded by a teacher by rubrics (provided).

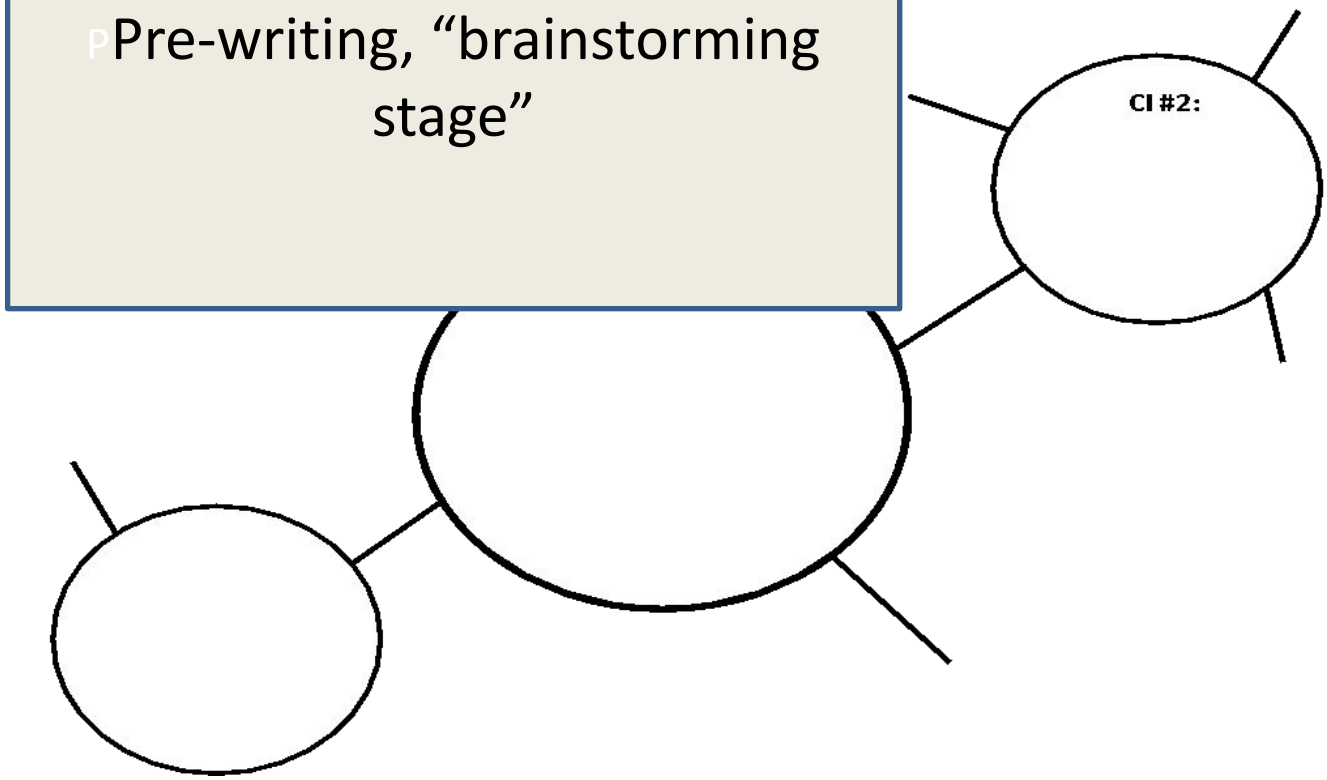
Brainstorm by "free writing"

Simply jot down in the space below anything about your subject (thesis topic and controlling ideas) that comes to mind. The idea is to keep writing without stopping. It doesn't matter if you drift off topic – just continue writing without being critical of yourself. Don't worry at all about grammar and spelling. Just write!

Brainstorm with a "cluster diagram"

Write your thesis topic in the center circle and its controlling ideas (CI) in the surrounding circles. Also feel free to brainstorm *supporting details* for each of the controlling ideas.

Pre-writing, "brainstorming stage"



Units 1-2. 4th week.

Problem writing assignment.

Taking into account the module videos, texts, class exercises, SPRE team analysis, PDs, you must:

- Write an introductory paragraph containing a clever hook, a brief overview of the Module problem, a good thesis , etc.
- Develop each problem in separate body paragraphs.
- Support each problem you state by way of clear examples, sound reasoning and credible evidence.
- Write a concluding paragraph, where you restate your thesis and leave a reader with a thought provoking concluding remark.
- Include 2 or three in-text citations.

Introductory paragraph

- Step 1. Come up with a clever hook, one that captures your readers' attention.

  _____

  _____

- Step 2. Provide your readers with a brief overview of the unit problem.

  _____

  _____

- Set forth your thesis.

1. Thesis topic_____
2. Thesis controlling ideas

   a _____

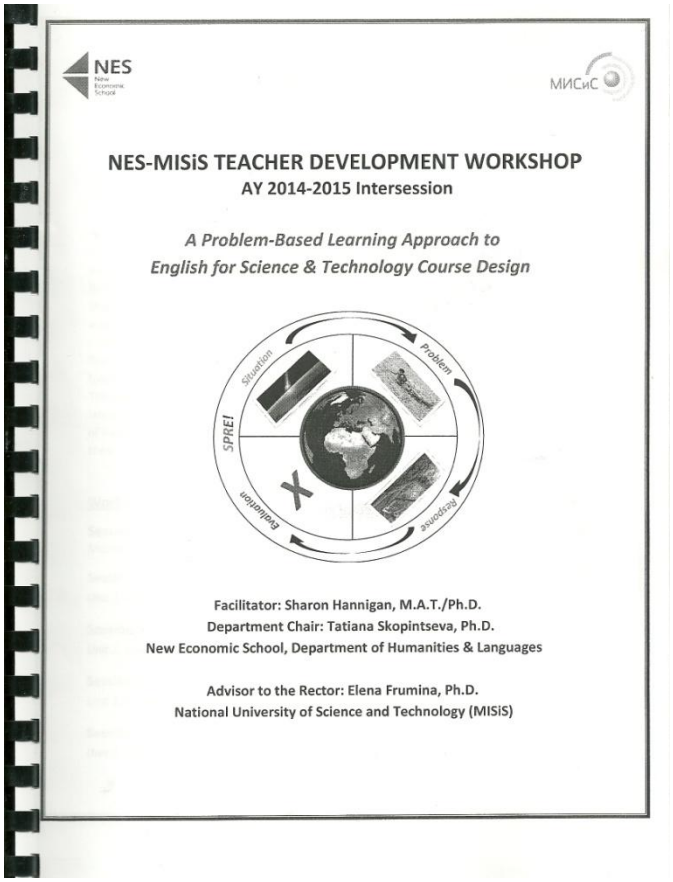
   b _____

Writing rubric (sample)

Task response	5 points	Problem
		Response
		Evaluation
Organization & discourse	10 points	Introductory paragraph
		Body paragraphs
		Concluding paragraph
Written fluency	5 points	Clarity
		Word choice
		Style
Mechanics	5 points	Sentence structure
		Spelling
		Grammar

Teacher support

All teachers will be provided with a booklet with a course description, materials and exercises, which they are to return to the department;



Teacher support

- A resource pack of materials in a www.dropbox.com (*rossog&rambler.ru; password ESP2015),* containing:
  - videos with exercises;
  - texts with exercises;
  - problem descriptions (to choose only one for each group);
  - supplementary materials and links to more;
  - Sharon's materials: samples of students' writing; exercises; grading rubrics, etc.