

Toolboxes for SuperFastLearning digital contents in STEM

Example presentation Inquiry-based-learning

CONTEXT

The example of inquiry-based learning (IBL) proposed here concerns a 80-minutes-lecture. There are 23 students, all in the 3rd year of university (in France, this is their last year to pass a certification called "Licence"). The course's name is "Plant for the Futur"(P4F). This session's name is "Biotic and abiotic stress". No requirements are necessary for the students enrolled in a university biology course. The course credits are 3 ECTS. During this session, the students are divided into 4 groups (5 to 6 students per group) and their learning activities are supervised by a single tutor.

GOALS AND OBJECTIVES OF P4F COURSE

Understanding plant physiology is even more important in the context of climate change. Students need to learn how to examine plant function from different angles. The goal of « Plant for the Futur (P4F) is to show the student how useful are the technical routes (ITK) in agriculture and what are the different levers to reinforce the plant immunity to cope with emerging diseases in the context of climate change. They will study the basics of tomato plant culture interacting with their environment to analyze various scenari in conditions of biotic and abiotic stress.

Inquiry-based learning (IBL) is a pedagogical approach very quite appropriate in this case. Indeed, students start from a question, investigate the solutions, reflect, and communicate findings, and create new knowledge based on the collected evidence.

INTENDED LEARNING OUTCOMES (ILOs) OF THIS SESSION

Three main learning outcomes are intended. At the end of the session, students will be able to:

- 1) Analyze the targeted objectives and the key operations of an ITK by taking into account the biological specificities of the cultivated plant and to a given context.
- 2) Communicate the specificities of an ITK and the results of comparative analysis (oral and written).
- 3) Carry out this work alone and to enrich their method of analysis in a team.



METHOD TO SELECT THE QUESTIONS BASED ON SFLM

After having formulated, then selected the class learning outcomes, I selected four publications. I have submitted them to the SFL machine. A Total of 130 questions were extracted. First, I read the question and put in red the unintelligible and the doubled questions. Secondly, I selected the questions with bloom_taxonomy (avoiding evaluation) and I checked the relevance of these questions. Finally, I selected two documents among the fourth submitted and five questions per document to have a list of 10 inquiry questions.

To have more details about the selection, please refer to:

[P4F_TD7_10_inquiry-questions_selected.xlsx, sheet "10 P4F questions"](#)

LIST OF THE TEN QUESTIONS SELECTED FROM SFLM OUTPUTS

1. How ABA – defence signalling interactions the outcome is affected by the host and pathosystem as well as?
2. In which conditions K^+ and SO_4^{2-} concentrations were decreased under salt stress with no differences observed between the different salinity levels?
3. What callose deposition is associated?
4. In which conditions a significant reduction in the expression of DHN - TAS was observed under combined stress for MM and NIL - ol-1 (ranging from 2- to 7 - fold?
5. In which conditions downregulation of adaptive and protective mechanisms involved in abiotic stress tolerance such as ABA signalling (evidenced by the reduction in DHN - TAS expression) and the reduced expression of APX and SOD under combined stress contributed to decreased tolerance (Faize et al . , 2011 ; Muñoz - Mayor et al. , 2012)?
6. How under drought conditions stomatal closure imposed a limitation on photosynthesis?
7. Why for example during heat stress plants increase their stomatal conductance?
8. How for example during heat stress plants increase their stomatal conductance?
9. Why for example the effects of salinity stress could be exacerbated when combined with heat stress?
10. How the effects of heat or drought and heat combination on photosynthetic rate were severe?



CLASS MATERIALS

For this session, students will have this material:

Before the class

- = [TD#1_Analyse_Video_english.pdf](#)
- = Two videos in french : [Video 1](#) and [Video 2](#)

During the class

- = [P4F_TD7_SB2_Doc10.pdf](#) (academic publication)
- = [P4F_TD7_SB2_Doc8.pdf](#) (academic publication)

The ten selected questions from SFLM outputs

COURSE FLOW: organization of the students activities with one tutor

Before the class (asynchronous learning)

Before the class, students have to spend a minimum of 30 minutes to watch two 5-minutes videos on the course thema and to analyze it. The link of these videos is available for students 15 days before on a Moodle P4F course space. They must submit their analysis assignment one day before the session on the Moodle P4F course space. For this purpose, they have a document to guide their analysis. The links of the two videos proposed are indicated on this document ([TD#1_Analyse_Video_english.pdf](#)). The videos would allow students to understand the background of the topic provided and to be able to better understand the publications.

During the class (synchronous learning)

At the beginning of the session, the students receive the publication section and the list of ten inquiry questions. This list is the same for all the students of the class. The students must propose ten answers by analyzing the publication.

During the face-to-face session of the class of tutorial (80 min), the students, each alone, have to read a part of a publication, to interpret and analyze and assess data, evidence, information described in the academic publication. Then, they have to exchange their point of view among themselves to answer a series of ten inquiry questions and potentially construct new knowledge. The students are divided into 4 groups (5 to 6 students per group, A, B, C, D). Each group must analyze a different section from the two selected publications (half of the publication, a total of four sections for four groups).

The session of class of tutorial takes place in five steps :

1) Each student read a part of the publication and to interpret and analyze and assess data, evidence, information described in the academic publication. The half of the publication is not enough to answer the 10 questions. Duration: 10 min



2) Time of exchange in the group to answer the ten questions. They have to exchange their point of view among themselves to answer a series of ten inquiry questions and potentially construct new knowledge. They must begin to write the proposed answers. Duration: 10 min

3) Time to change the groups (for example, a new group is formed by students from A+A+B+C+D) and to exchange again with the new information of the 3 other sections of the both publications. At least one student in this new group has knowledge of one of the 4 sections of the two publications. Students have to synthesize all types of data (results, information...) and to make critical judgments based on the reliability of the information and to justify their answer. They are in a situation to draw and evaluate conclusions. Then, each group is able to answer all questions. Duration: 10 min

4) Time for exchange in class with all the students to review the ten answers. By using correct language, they have to communicate orally in class and in writing their ten answers, clearly, logically, and effectively. They collaborate with others to deepen learning. Duration: 10 min

5) Then, I will do the lecture to possibly correct the ten answers and to complete them. Students must take notes. Duration : 40 min

ASSESSMENT

Different ways are considered to evaluate this IBL session:

First, to evaluate my IBL sequence, I choose to observe and to register the discussions with the students during the session. Moreover, I engage the students in self-reflection by completing a survey.

In order to evaluate if the IOLs are reached, a final exam is programmed at the end of the course P4F.

This lesson is designed by Cabasson Cécile, Associated Professor at University of Bordeaux



FEEDBACK on IBL experience

The class of tutorial took place the 2th March with 17 students present (on 23 expected) divided in five groups of 4-5 students.

The students had different behaviors during the first step. Some of them started by reading :

- the 10 questions (<5 students)
- the abstract of the publication (2 students)
- the results of the publication (most of the students)

Two students were lost and checked the pedagogical instructions/objectives with their peers in spite of the restriction of exchanges during this step.

Group's feedback

Group1: The four students didn't understand why they couldn't find all the answers to all the questions from their publication.

Group 2: The four students found the publication too complex. One of them would have liked to read it before the session. The exchange was only between two students (2 boys).

Group 3: Pedagogical instructions were well understood. The five students selected the questions corresponding to their publication. They found that the questions were too precise compared to the amount of information in the publication. They asked if they can write on the publication (lack in the pedagogical instructions). Very rich exchanges.

Group 4: Pedagogical instructions were well understood. The four students selected the questions corresponding to their publication. They were frustrated not to have a full copy of the publication by anyone. Very rich exchanges.

In conclusion, the students were surprised by the questions. They needed more time to exchange ideas in order to be able to propose answers to certain questions (step 2 and 3).

Results of the work

- Group1: 4 written answers
- Group2: 4 written answers
- Group3: 9 written answers
- Group4: 9 written responses

Tutor's feedback

At the end of each step (2, 3), I went by group to check that they did not have any blocking points in their work. I had the impression that they appreciated my asking



about it. As the focus on the work slackened during the step 3 (notably for group 3, 3 girls), I proposed they come back in their initial group to review their answers (step 3 bisadded). During step 4, they communicate their results easily. They have understood the need to understand complex issues related to the course topic. They recognized that they would have been less efficient in understanding these two publications by working alone and that work would have been time-consuming. This work made them feel valued and was an insight into the methods of working in a master's program. The students had time to answer the survey after step 4 of the session. Then, I had less than 10 minutes to do the lecture (step 5). Maybe, the pace of this session should be re-evaluated. I answered the survey 5 days after the session