

Toolboxes for SuperFastLearning digital contents in STEM

CHOOSING AN IoT PLATFORM a PBL exercise



COURSE DESIGNING

CHECKING YOUR COMPLEX PROBLEM

	How to check?	Assessment
G Good	F Fair	TBI to be improved
Problem Interest and motivation (PIM)		
New problem	Will the students need to analyse and explore the situation before starting a solving process?	G
Problem relevant to Curriculum-	Will the students consider the PBL problem relies to their curriculum and to the ILOs of their training programme?	G
Context-induced motivation	Will the context be a source of motivation and interest? How can I improve them?	G
Contextualisation details	Is the context correctly described? How can I improve it?	G
PBL sequence ILOs	Will the goals be a source of motivation and interest? Are they correctly expressed? How can I improve them?	G
Learning process (LP)		
Relevant to ILOs	Has the problem been defined to attain the ILOs ? Can it be improved?	G
Relevant to pre-existing knowledge	Will students need to recall their existing knowledge as an input in their method? Can it be improved?	G
Teamwork	Does the problem need a group work to be solved ? Can the problem be improved?	F
Feasibility conditions (FC)		
Difficulty	Is the problem difficult enough for learning? Isn't the problem too difficult for solving?	G
Scheduling	Is the schedule of sessions suitable for handling the PBL problem? Does it need adjustment?	G
Resources	Are sufficient pedagogical resources provided? Are students guided enough for their own research? Is an improvement needed?	G
PBL training results (PTR)		
Intended learning outcomes (ILO)	Have the intended learning outcomes (ILO) been precisely defined?	G
Learning outcomes assessment	Has the assessment been included in the PBL process?	F

From that, we can conclude that our problem met the criteria provided in the pedagogical guidelines.



DOCUMENTS SELECTED AND UPLOADED IN SFLM?

The SFLM machine was fed with the below resources:

- 10 Best IoT Platforms To Watch Out In 2022: <https://www.softwaretestinghelp.com/best-iot-platforms/>
- 10 Best IoT Platforms for 2022 SaM Solutions: <https://www.sam-solutions.com/blog/top-iot-platforms/>
- Industrial IoT Platforms Reviews 2022 Gartner Peer Insights: <https://www.gartner.com/reviews/market/industrial-iot-platforms>
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- 12 Open Source Internet of Things (IoT) Platforms and Tools: <https://geekflare.com/iot-platform-tools/>
- Top 5 IoT Development Platforms in 2021: <https://www.ietfforall.com/top-5-iot-development-platforms-in-2021>
- 14 of the Best IoT Platforms to Watch in 2021 - IoT Tech Trends: <https://www.iotechtrends.com/best-iot-platforms/>

All of them were downloaded in TXT format and fed to the SFLM. We tried first to make this work in PDF and with these PDF transformed to DOCX, but the SFLM could not work with them.

SFLM OUTPUTS AND HOW DID YOU USE IT

The SFLM output was the following one. Initially, we have planned to reduce the number of websites to be provided to the students by eliminating the ones that have not good rates (in green). Finally, we decided to leave “12 Open Source Internet of Things (IoT) Platforms and Tools” because it is the only one that focus only in Open Source platforms.

	keyword	overall relevance	10 Best IoT Platforms To Watch Out In 2022	10 Best IoT Platforms for 2022 SaM Solutions	Industrial IoT Platforms Reviews 2022	IoT Platform Companies Landscape 2021_2022	12 Open Source Internet of Things (IoT) Platforms and Tools	Top 5 IoT Development Platforms in 2021	14 of the Best IoT Platforms to Watch in 2021 - IoT Tech Trends
0	services	0,61157	0,6385	0,6675	0,6492	0,4948	0,6239	0,6031	
1	data	0,610818	0,6013	0,6193	0,6125	0,6364	0,5592	0,6031	0,6267
2	platforms	0,609919	0,6006	0,5905	0,6587	0,6521	0,482	0,6257	0,5678
3	internet	0,607757	0,6006	0,6323	0,6587	0,6521	0,598	0,4794	0,5076
4	iot	0,599766	0,6345	0,6063	0,5789	0,5793	0,6073	0,6031	0,5748
5	edge	0,59947	0,6234	0,6675	0,4999	0,5471	0,6234	0,5986	0,5348
6	industrial	0,590621	0,5292	0,5573	0,6587	0,5806		0,6506	0,5789
7	management	0,589802	0,6234	0,5013	0,375	0,6364	0,6234	0,6506	
8	platform	0,583706	0,5627	0,5974	0,5724	0,6119	0,5765	0,5626	0,5915
9	cloud	0,579633	0,6106	0,6153	0,5321	0,5653	0,5066	0,6031	0,5748



WHAT CHOICES WILL YOU MAKE IN FUNCTION OF YOUR CONTEXT?

Issue	Solution	Remarks
Number of students	Adjust the number of tutors. 1 tutor for 2-6 groups	A beginner tutor would only deal with two groups. Even one group for the very first time would be better. All tutors should perfectly know the ILOs and coordination meetings should be carried before the beginning of the sequence <u>For this example presentation, we want to make 2 groups of 6 students</u>
Online teaching	Use breakoutrooms when students work in small groups For tutors who are used and feel well with online teaching, a in-class teaching PBL sequence may be transposed online Online teaching may be avoided for tutors who are beginner in both PBL approach and online teaching	Keep in mind that it is more difficult to efficiently allocate time between groups in virtual rooms than in between groups in a real room <u>This course is online so we have no option for using a real room</u>
Time constraints	When individual work time is too short, documentation should be provided to the students and it should be appropriate with the time frame When individual work time is too long, i.e. there are several days between the first phase and the final phase, the time required for the individual work should be indicated to the students, and, if possible should be scheduled in the timetables	<u>For this example presentation, document was provided and timing was indicated for individual work</u>
Theoretic vs know-how intended learning outcomes (ILOs)	No major difference between these two kinds of ILOs about the implementation of a PBL sequence Tutors have to ensure that students have access to the required documentation for the two kinds of ILOs, and to the required material for know-how ILOs	Students won't memorize the concepts; they will research and use them to "know how" <u>For this exercise, it is necessary that the theoretical concepts have been studied before, because the work to be done have to be built over this knowledge.</u>



Debriefing time	<p>Given the PBL approach is fruitful because it is based on active learning principle, it is important, when organized, that the "whole class" debriefing time keeps the spirit of active learning.</p> <p>Tutors should avoid to give solutions. They should question students so that they give the intended solutions by themselves.</p> <p>During that time, tutors should keep their role of tutors and should not come back to a teacher position.</p>	<p>A debriefing time is not included in the "classic" PBL sequence. Several tutors find it useful to organise "whole class" debriefing time.</p> <p><u>For this example presentation, debriefing time was included in the Go phase and Return phase</u></p>
All [above mentioned and other] adaptations	<p>During a PBL sequence adaptation, tutors should keep in mind that the ILOs are the target of the sequence. At each step of the PBL sequence building or adaptation, tutors should ask whether the decision they take is the best way to serve the cause of ILOs</p> <p>Active learning: Always bring the students to find solutions by themselves by questioning them rather than giving them solutions Tutors should encourage solutions and answers proposed by students Tutors should encourage self-organisation of the groups</p>	<p>These two conceptual tools should be considered as the main threads for taking decisions and making choices between putative options, both for the conception and for the adaptations of PBL sequences.</p> <p><u>See booklet for comments and adaption</u></p>

CHECKING YOUR ASSESSMENT

	How to check?	Assessment
G Good	F Fair	TBI to be improved
Monitoring Student Progress		
Target	Has assessment been defined to evaluate the ILO?	G
Misconception	Is it possible that likely misconceptions may occur?	F
Feedback	Is a feedback possible?	F
Additional help	Is it possible propose additional help to achieve assessment ?	F
Self and peer review		
Resources	Were the resources enough for learning	G
Ability	Is it possible to observe ability, achievement, learning and needs?	G
Type	Is there an effect of the assessment format on the results?	G



CONTEXT AND BACKGROUND

The University of Zaragoza has a Master's Degree in Cable Transport Installations that is the proposal offered from the University to the demands made from industrial and business areas regarding the need to train specialists and technicians of the highest level of qualification in this professional field.

The Master's Degree in Cable Transport is organized by the School of Engineering and Architecture of the University of Zaragoza. In this Master's Degree, there is the participation and collaboration of different university departments whose teaching staff perfectly covers the teaching needs in the different areas of study, as well as the collaboration of professionals who are specialists in their field and who have experience and a professional career in this field.

The Master's Degree in Cable Transport is a training program of 600 working hours that will allow students to acquire a solid training in different aspects related to the problems of cable transport. At the same time, students will analyze a wide range of problems in the field of business and learn how to deal with and solve them with the help of university lecturers and experts from the business world.

The structure of the program is the following:

- Module A. Introduction and general aspects of installations.
- Module B. Environment of Cable Transport Installations.
- Module C. Intensification in planning and management aspects.
- Module D. Intensification in aspects of design and calculation.
- Module E. Module of specializations and applications.
- Module F. Master's Thesis.

Module B has 10 submodules, one of them (B6) related with Information Systems and Internal Communication Systems, External Information Networks, and Sensorization. This module includes the following exercise based on PBL.



TUTOR BOOKLET

OVERVIEW

Global recommendations to your tutors (to be filled by teacher) [Course 2021/2022]

R.1: The class is made up of 12 students that are developing this Master Degree in remote mode, while they are working, and from different countries across the world. There is one student in Canada, another one in Chile, and the other ones in Spain. All of them speak Spanish as their mother-language. Nevertheless, the SWOT analysis (Strengths, Weaknesses, Opportunities y Threats¹) should be provided in English as an effort for using the common language that will be necessary in case they have to make an international presentation of their work.

R.2: We are going to create two different groups (6 people each) for making this exercise. These two groups will be created in the Moodle platform in order to give them local forums as well as space for sharing documents. Students have to use these resources in order to give tutors the opportunity for following the progress of the exercise.

R.3: Before making this exercise, students have to read the document provided as theoretical background.

You may avoid drifts and manage time with the following questions.	They can redirect students with the following questions.
<ul style="list-style-type: none"> • Can we return to a more methodical approach? • Who can summarize what we have found so far? • Can we go back to our discussion plan? • Since we are making little progress, can we write down a study question? • Could we look for other hypotheses now? 	<ul style="list-style-type: none"> • What is the main problem? • Is there an inconsistency? Which one? • What is expected from your group? • Are you sure this is what is expected from you? • What relevant information did you find in the situation?

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¹ https://en.wikipedia.org/wiki/SWOT_analysis



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THE COMPLEX PROBLEM

The students are part of a consultancy company that has been contracted by a sky station (according with the confidentiality agreement signed, the name of the sky station and its location cannot be provided) for making a previous analysis for choosing an Internet of Things (IoT) platform that will be the base of the sensorization of all physical elements that are part of the infrastructure (cables, towers, cabins, chairs, ...). Students, working in groups, have to select four alternatives and provide a SWOT analysis for each one of them.

WHAT STUDENTS SHOULD PLAN (=FIRST PHASE) TO PRODUCE/DELIVER/EXPLAIN/CREATE DURING THIS PBL

Working in groups, students have to identify the four most interesting IoT platforms for achieving the problem. This implies that each one has to select four options and to develop the corresponding four SWOTs. Then, they have to share their proposal with the other ones and to select the four options that will be part of the deliverable to be presented. Finally, they have to elaborate a report with the four SWOTs of the final selections.

RESOURCES TO GIVE TO STUDENTS

Students should work over a list of websites that develops different approaches to the state of the art in IoT platforms. The suggestion is to use the following ones:

- 10 Best IoT Platforms for 2022 SaM Solutions: <https://www.sam-solutions.com/blog/top-iot-platforms/>
- Industrial IoT Platforms Reviews 2022 Gartner Peer Insights: <https://www.gartner.com/reviews/market/industrial-iot-platforms>
- IoT Platform Companies Landscape 2021_2022: <https://iot-analytics.com/iot-platform-companies-landscape/>
- 12 Open Source Internet of Things (IoT) Platforms and Tools: <https://geekflare.com/iot-platform-tools/>



- Top 5 IoT Development Platforms in 2021: <https://www.iotforall.com/top-5-iot-development-platforms-in-2021>

PLANNING OF THE ACTIVITY

Phase	Duration	Steps	Explanations
First phase In group In class	5 min	Organise the group	Divide up the roles: Depending on the number of students per group, you may take one major and one minor function, eg. “time keeper & facilitator” “secretary & reviewer”.
	10 min	Discover and rephrase the problem	<p>Read the document provided Individual work: everyone does an initial overview of the booklet to familiarise themselves with its contents.</p> <p>Understand and clarify the problem What exactly is the problem we are going to address? The scribe starts to note down what appears in the exchanges (keywords, concepts, ideas, etc.).</p>
	15 min	Design pathway	Establish a list of relevant questions. Take stock of what the team knows (and does not know) based on both the group and individual backgrounds. If necessary, draw up a list of restrictions to limit the scope of the problem (if necessary, check with the tutor). Draw up a list of expected outputs. Consider different ways of dealing with the task. The activator launches and relaunches the discussion when necessary.
	10 min	Define the knowledge needed	<p>Clarify the learning outcomes What do we need to (re-)learn / discover to deal with the problem? What questions will each of us need to be able to answer? What will we need to be able to do?</p>
	10 min	Define a working plan	<p>Determine what information needs to be gathered to confirm or invalidate your first thoughts. List the tasks to be done and deliverables to be prepared by everyone before the next session. The secretary notes what is decided and arranges to communicate it to the other team members.</p> <p><i>Tutor: Make sure that the tasks to be done include the analysis of four solutions by each student, and not just to assign one to each one.</i></p>



Phase	Duration	Steps	Explanations
Second Phase Individually At home	Two weeks 14 hours	Implement the action plan	<p>Each student in the group has to work on every step that have been defined in the action plan. You will collect and analyse information in order to be able to explain and solve the problem.</p> <p>1- Individual home work (estimated time 10 hours)</p> <p>Each student provides the necessary work defined during the 1st phase (exploitation of resources, research on identified key points, data manipulation).</p> <p>It is highly recommended that communication between students is kept to a minimum during this phase. This will ensure fruitful sharing during the final phase.</p> <p>2- Preparation of deliverables (estimated time 4 hours)</p> <p>Each student prepares a detailed report of the results of his or her work to be shared during the final phase. As the individual report should be synthetic, graphics and bullet points are highly encouraged as well as a “one slide per task” format.</p>

Phase	Duration	Steps	Explanations
Final Phase In group In class	45 min	Determine the role of each partner	Quickly check the roles of each student in the group, make sure that the essential roles are provided. You can change roles if needed.
		Share everyone's production	Each student presents his/her findings and individual proposal of four IoT alternatives, and the corresponding SWOTs for each ones. Students have to select the final four alternatives that will be part of the final deliverable. It is expected that each one will propose his/her selection providing the arguments that should convince the other ones. A vote for the selection of the four IoT platforms can be organized if necessary.
	45 min	Prepare the deliverable	The final collective output consists of a report that include the four SWOTs for the IoT selected platforms. These SWOT have to take into account the initial SWOTs proposed by each students, as well as the contributions that could be provided by the other students during the preparation of the deliverable.
	30 min	Assess	You will assess alone the group work. Compare all together your answers. Then assess individually your learning outcomes and your work.



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	30 min	Assess	You will assess alone the group work. Compare all together your answers. Then assess individually your learning outcomes and your work.



Roles in the group:

	<p>The driver ensures the progress of the group work. They make sure each step is realised. They alert when a task is forgotten and should find collective solutions when required.</p>
	<p>The time keeper is responsible for the schedule of the collective work. They ensure an optimal use of the time available.</p>
	<p>The scribe writes all the points that have been discussed, whatever they are and all the positions expressed during the meeting(s). They write them on a blackboard, paperboard or any other writing surface that can be viewed by each group member. .</p>
	<p>The facilitator's role is key to ensure that everyone can express their opinion freely, and to carry out the goal of the meeting. They can help to develop a common understanding and to create a pleasant working climate.</p>
	<p>The secretary is in charge of synthesising the main ideas, hypotheses, decisions taken and working results of the group. They are in charge of communicating these data to the group members.</p>
	<p>The speaker talks about the process, work status and the results of the group to the teacher, the tutor, the whole class or to any external person.</p>



ASSESSMENT

Evaluation of the group work

You will assess individually the group work: on a scale from 1 to 5:

Assessment	Totally no	no	yes	Totally yes
About the group's outputs				
Did the group follow each step of PBL sequence?				
Did the group acquire the intended learning outcomes?				
Did the group produce what was asked?				
About the group's organisation				
Were the group climate and interactions favourable for efficiency?				
Could everyone express themselves?				
How could be improve the group's work?				
Did everyone keep their role during the phase?				
Self-assessment				
How qualitative and efficient were my interactions with the group?				
How qualitative and efficient was my production?				
About the complex problem				
Was the topic interesting?				
About the relation with the tutor				
Did the tutor guide the group effectively, by asking the good questions to redirect when needed?				



Evaluation of the problem-based learning sequence

Each student auto-evaluates his learning by answering a questionnaire focused on the Intended Learning Outcomes: (scale 0-nothing 5-a lot)

1- How much did you know before the lesson about IoT platforms?

0 1 2 3 4 5

2- How much do you know now about IoT platforms?

0 1 2 3 4 5

3- How deep has been your study about IoT platforms?

0 1 2 3 4 5

4- How deep has been the study of your partners about IoT platforms?

0 1 2 3 4 5

Evaluation of the individual work

Please give your individual SWOTs to be graded by the teacher



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