

# Applying a Software Learning Platform to Implement a Project Based Methodology in Teaching Mechanical Engineering to Undergraduates\*

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The aid of learning management systems, widely spread among educational institutions, can enhance Project-Based Learning (PjBL) methodologies. Learning platforms allow self-learning and interaction with contents and materials anytime and anywhere using laptops and even mobile devices. This work explains a PjBL focused on engineering subjects conducted on a learning platform. In the frame of a “Motor and Generating Machines” course, 14 students analyzed an actual power plant run by biomass, in particular by dry olive pomace waste. The activities of the methodology are scheduled, presented, collected, and evaluated thanks to the learning platform. Through these activities, students learn and practice: power input and output estimation, biomass consumption, thermal efficiency, and power plant components. The activity includes an online test for student self-learning. The results from applying the PjBL methodology supported by a learning platform show that students easily understand the components of an actual thermal power plant and obtain most of the necessary energy parameters needed to manage the plant. However, exergy calculations are difficult for students since most of them did not correctly solve the questions related to this concept.

**Keywords:** self-learning methodology; Rankine cycle; biomass power plant; on-line learning tools; Project based learning

## 1. Introduction

Nowadays, there are methodologies searching for active learning, which is a potential characteristic of the learner-centred methodology [1]. A well-known example is the problem-based learning (PBL) methodology [2] aiming for active learning through small case examples or real-life projects called “authentic problems” by Sipes [3]. Conventional engineering education is considered to be deductive. According to previous authors, alternative approaches for teaching are called inductive methods [4]. These methods have some aspects in common, such as the fact that they are focused on the learner, who takes more responsibility for his or her own learning. Therefore, this methodology encourages student self-motivation, improving learning outcomes [5]. PBL and project-based learning (PjBl) methodologies have been widely investigated, and numerous studies have been published whose results support the effectiveness of this methodology in developing students’ professional knowledge and transferable skills [6]. Previous researches have observed that PBL and PjBL increase metacognitive self-regulation of the students, in peer learning and a decrease in time/study environment [7]. Even more, PjBL based on the potential of the student’s region has demonstrated to be effective in raising

their motivation and interest so that they learn more actively [8].

The increase in the use of information and communication technologies (ICT) in higher education institutions (HEIs) could greatly support the implementation and execution of PBL. In the last decade, and fundamentally oriented towards computer science education, work has been done on the development of specific programs to implement PBL methodologies; however, these environments are appropriate just in specific situations [9]. For this reason, it has also been analyzed how to use generic learning platforms for this purpose. Authors such as Domínguez and Jaime [10] observed better results in those students who took a PjBL methodology supported by a learning platform compared to those that followed a traditional strategy (teacher-centred). Yağci [11] concluded that online PBL positively affected students’ academic achievement scores. However, despite the adherence of Higher institutions to digital learning platforms in recent years and their potential advantages in supporting a PBL, scholars such as Ørngreen et al. [12] and Escorcía-Guzmán et al. [13] revealed that these learning platforms are mainly used for sharing information and teaching materials, and there is a lack of focus on implementing PBL methodologies.

This work shows how to implement a PjBL methodology supported by a learning platform. The idea is to motivate the students with real

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technical problems presented in a more attractive way and increase the interaction with the engineering contents because learning platforms are available anytime and anywhere using laptops and even mobile devices. Furthermore, supported by the learning platform, it is also proposed to generate the project starting data for each student, providing personalized automatic feedback and, using the statistics collected in the learning platform, identify the contents and technical skills most difficult for students to acquire.

The studies above prove the PjBL advantages in student motivation and results. This work focuses on the following research questions: Can PjBL be straightforwardly implemented using learning platforms in a regular course? And which learning platform tools can aid teacher tasks such as data presentation, activities personalization, automatic feedback, and identification of more complex course topics?

To understand the methodology described in Section 2, we explain its application for introducing engineering students to the analysis of the actual data of a 16 MW power plant (Section 3). Section 4 shows the students' results, which allow determining the most complex contents for the students. Finally, the main conclusions are drawn in Section 5.

## 2. Methodology

Our approach requires the following elements:

- Real situation. Finding an adequate technical topic is the first step of our methodology. Although the trainer can define the topic for himself, it could be helpful to contact local company partners interested in collaborating in the learning process, such as in the case of this experience. It is also needed to detail the problem by identifying assumptions, queries, and questions.
- Learning goals and technical skills to train through the real problem. For this experience:
  - Become familiar with power plant diagrams.
  - Identify the fundamental components of the plant shown in the diagram.
  - Obtain temperature, pressure, or enthalpy data from the power plant diagram.
  - Apply the thermodynamic knowledge acquired in the subject.
  - Obtain the efficiency of each component.
  - Obtain the efficiency of the power plant.
  - Determine energy consumed.
  - Calculate energy delivered.
  - Quantify the volume of biomass needed.
  - Analyze possible aspects that can be improved in the installation operation.
- Teaching aids and materials. In this experience,

PjBL activities are supported by different tools of the learning platform Ilias [14]. Ilias is a learning management system developed for universities, among other applications. Some advantages of this platform are versatility, reliability, open-source, conforming to standards, for a large number of users (up to 100,000), and availability for desktop or mobile devices. Ilias allows course management and provides tools such as learning modules, tests and assessments, portfolios, surveys, wikis, and blogs.

- Activities. With the technical description ready, we must think about how to accomplish the PjBL. We propose the following activities performed sequentially:
  - Theoretical sessions about the main PjBL topic. In the learning platform, the student can find slides that summarize the engineering contents to be studied and a guide for using the PjBL platform activity.
  - Student Self-learning in Ilias platform. After the theoretical session, the students are informed that in 2 weeks, they must complete a PjBL activity implemented in the learning platform (Section 3 describes the implementation done). Until the due date, the students can freely access and train with the PjBL activity, which was programmed to provide different scenarios and automatic feedback.
  - Problem resolution. Finally, the students complete the activity, and the results of their test and the statistics of their tries are assessed to evaluate the methodology's success.
- Evaluation. Ilias helps collect the students' results; therefore, assessing student performance regarding the learning goals is straightforward. Moreover, we propose to use this evaluation information to identify students learning gaps, which can help the trainers to improve the methodology.

## 3. Real-Life Situation

The methodology described in Section 2 has been applied in the Energy Engineering degree of the Higher Polytechnic School of Linares at the University of Jaén, in the subject "Motor and Generating Machines," a compulsory subject of 6 credits taught in the 2nd semester of the third year. This subject is the students' first contact with thermal engineering. However, it aims to be a practical approach so that students understand and know how to make calculations related to thermal power plants, such as Rankine, Brayton, and combined cycles [15].

The methodology presented is also intended for the student to apply the contents learned, such as diagrams, equipment calculations, etc., to know

**Table 1.** Biomass power plants in the province of Jaén (Spain) (31 December 2021) [18]

Name of the Power Plant	Town	Installed capacity (MW)
Bionergética de Linares	Linares	15
La Loma	Villanueva del Arzobispo	16
Aldebarán Energía del Guadalquivir	Andújar	6

how an actual power plant works, starting from a brief description of the main characteristics of the power plant analyzed and a justification of its viability: the actual power plant under study uses biomass as fuel due to its great availability in the province of Jaén, mainly from olive farms. Jaén has the largest extension of olive groves on the planet, with 60 million olive trees over 550,000 hectares [16]. According to Ruiz-Arias et al. [17], the energetically usable waste from the olive grove in the province of Jaén (Spain) amounts to 750,000 t/year; with an approximate energy potential of 1 MWh/t of waste; whose use would generate 98 MW (distributed in at least 7 locations in the province). However, according to data from the Andalusian Energy Agency [18], the province of Jaén has a total of 37 MW installed for electricity generation from biomass (see Table 1), representing approximately 37% of the volume of biomass potential harnessed. Therefore, it is foreseeable that the number of existing plants will increase in the near future, and many of the current Energy Engineering degree students will likely participate directly or indirectly in said projects. Furthermore, according to the Association of Renewable Energy Companies (APPA) data, each installed megawatt obtained from biomass sustains 30 direct and indirect jobs [19].

The present PjBL focuses on studying the ther-

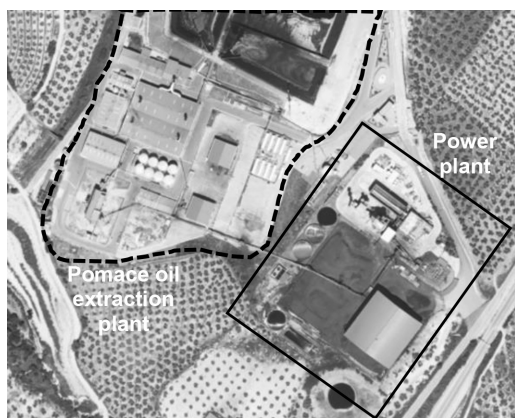
modynamic process of the 16 MW power plant placed in Villanueva del Arzobispo (see Fig. 1), called “La Loma”, which belongs to the ENCE group [20], which has recently received the “Zero Waste” environmental certificate, awarded by AENOR to those organizations that carry out an efficient recovery and management of their waste. This plant has been operational since 2003. In addition, in the same industrial complex, there is a pomace oil extraction plant called “San Miguel Arcangel”, whose residue, *orujillo*, is the biomass used as a fuel in the power plant. Before performing the activities implemented in the learning platform, a visit to the power plant is proposed so that students can identify this type of plant. However, since the experience was performed during the coronavirus pandemic, some photos were used for this purpose, such as the ones shown in Fig. 1.

The present didactic resource uses the components scheme of the power plant “La Loma” (see Fig. 2) as the master line. This scheme is a simplification of the actual power plant studied. The numeric values of the actual power plant have been erased and replaced by reference numbers because it is intended to protect the plant data and because we do not want to provide the students with the enthalpy values.

An online test was used to apply the present didactic resource, where several questions are proposed individually to each student. The test is self-corrected; in case of failure, the student can try again, or even it is possible to program the test to show the student the correct option.

### 3.1 Questions about Device Layout in the General Power Plant Scheme

Initial questions are intended for the student to overcome the first impression when they see the power plant scheme. For example, when they see



(a)



(b)

**Fig. 1.** (a) Aerial photograph of “La Loma” biomass power plant and the pomace oil extraction plant (source: Institute of Statistics and Cartography of Andalusia [21]). (b) Elevation photo of the power plant.

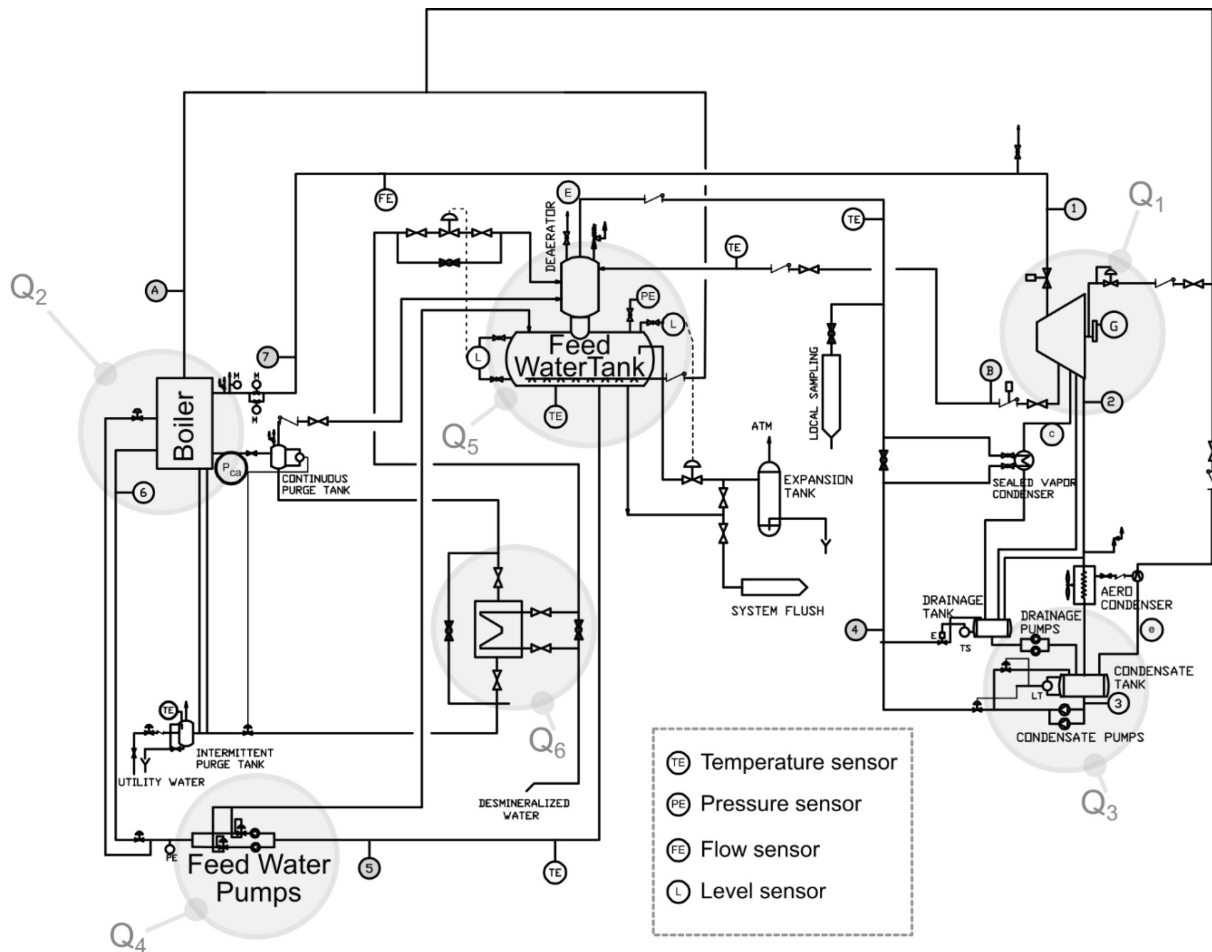


Fig. 2. Components scheme of a 16 MW biomass power plant.

the scheme for the first time, they usually think: “I understand nothing about this scheme; it is very complicated.” So, these questions are more straightforward and just about a single device so that the student can focus on a specific device and he/she can identify it without too much effort. Next, some questions that the students answer by clicking on the right place over the power plant scheme are presented. The questionnaire tool has been programmed to give a positive result if the student clicks near the right location:

**Q<sub>1</sub>.** “Find the Turbine and select its location with your computer mouse.” The area named Q<sub>1</sub> in Fig. 2 shows the correct answer.

**Q<sub>2</sub>.** “Find the Boiler and select its location with your computer mouse.” The area named Q<sub>2</sub> in Fig. 2 shows the correct answer.

**Q<sub>3</sub>.** “Point out where the low-pressure pumps are located.” The area named Q<sub>3</sub> in Fig. 2 shows the correct answer. The difficulty of the questions is growing; for that reason, from this point, some explanations are given as part of the learning process about the actual power plants. In ques-

tion 3, the following explanation is given: “In an actual power plant it is usual to double the pumps so that the reliability is higher because it is unlikely that two pumps broke simultaneously.”

**Q<sub>4</sub>.** “Point out where the high-pressure pumps are located.” The area named Q<sub>4</sub> in Fig. 2 shows the correct answer.

**Q<sub>5</sub>.** “Identify what device of the power plant can be studied like an open heat exchanger.” The area named Q<sub>5</sub> in Fig. 2 shows the correct answer.

**Q<sub>6</sub>.** “Point out if there is a closed heat exchanger in the power plant.” The area named Q<sub>6</sub> in Fig. 2 shows the correct answer. In this case, we explain to the students the advantages of a closed heat exchanger. For this reason, the following explanations are given via the online resource:

- “Due to the unavoidable leaks of superheated steam from the purge system or deterioration of the probe connections in the pipes over time, together with the drainage required in the expansion tank, it is necessary to supply a small flow of feed water into the circuit. It is crucial to demineralize this water to avoid future calcifications inside the equipment.”

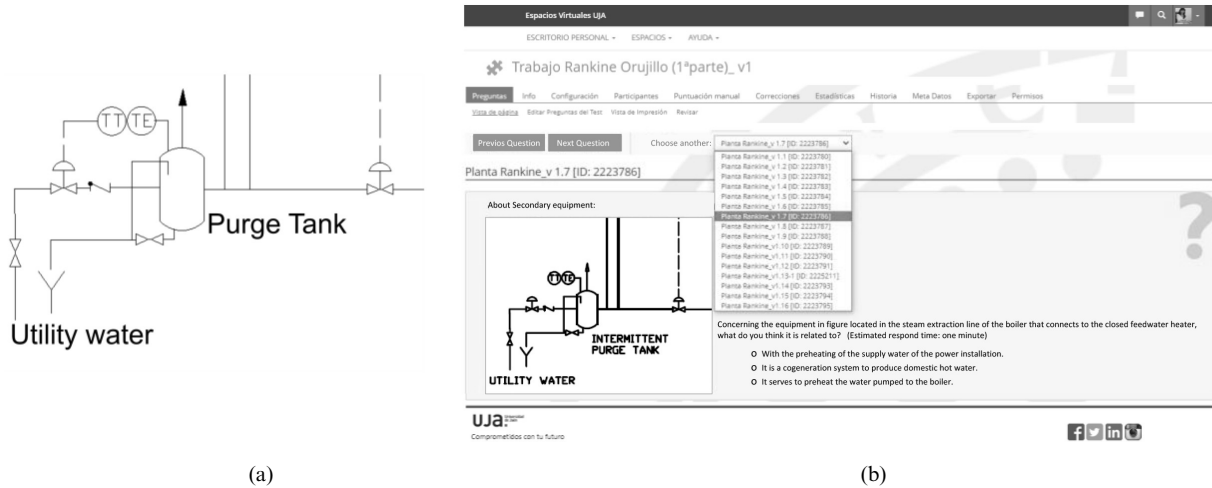


Fig. 3. (a) Scheme of a cogeneration system. (b) A screenshot of question Q<sub>8</sub>.

- “To preheat the water that enters the installation, it is typical to use a heat exchanger that warms up the water from the residual energy of the exhaust gases or a closed exchanger that takes advantage of a fraction of superheated steam obtained from the boiler.”

3.2 Analytic Questions

Once the student has become familiar with the scheme through the previous questions, the following questions are proposed so that the student analyzes the scheme in more detail.

Q<sub>7</sub>. About the condenser

The student must focus their attention on the equipment located between points 2 and 3 in the lower right area of Fig. 2. And then, they are asked to decide what type of condenser it is, choosing one of the following alternatives (answer c is the correct one):

- (a) Cooled by river water.
- (b) Cooled by a cooling tower.
- (c) Air-cooled.

Q<sub>8</sub>. About secondary equipment

Concerning the equipment in Fig. 3(a) located in the steam extraction line of the boiler that connects to the closed feedwater heater, what do you think it is related to?

- (a) With the preheating of the supply water of the power installation.
- (b) It is a cogeneration system to produce domestic hot water.
- (c) It serves to preheat the water pumped to the boiler.

This question aims for the student to remember the concept of cogeneration, which is the correct

answer. Fig. 3(b) shows a screenshot of question Q<sub>8</sub> to illustrate how the activities are displayed on the educational platform Ilias.

Q<sub>9</sub>. Correspondence between theory chapters and the actual power plant scheme.

The aim is for the student to be able to relate the diagram of the thermal power plant shown in Fig. 2 with the theoretical case that most closely resembles it. This is very important since it is the key for the student to apply the theoretical knowledge acquired at the university. In this question, the student must select which of the schemes shown in Fig. 4, 5, and 6 best suits the power plant under study. The correct answer is Fig. 5 since it represents a Rankine cycle with one regenerative stage via an open feedwater heater.

Q<sub>10</sub>. About the measurement devices

The target of this question is for the student to note the importance of measuring the thermodynamic variables at various points of the power plant. Secondly, the student must learn how to manage this information, thus becoming familiar with the

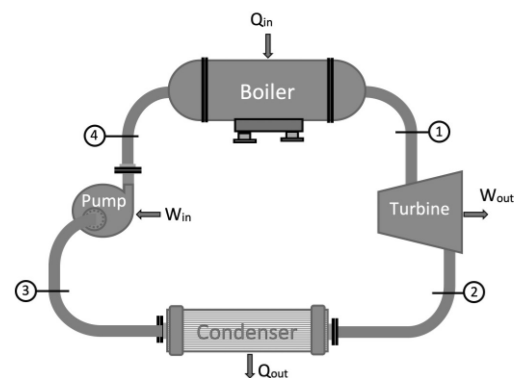


Fig. 4. Input and output numbering of the four main components of the Rankine cycle power system.

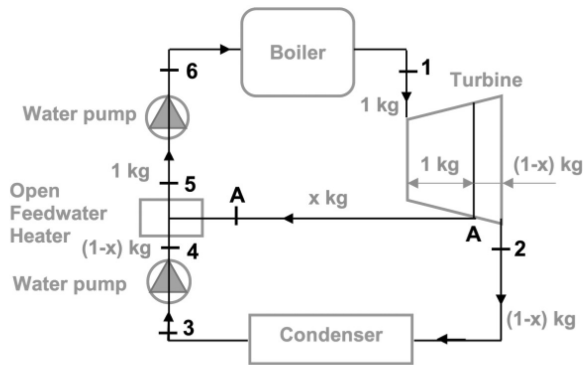


Fig. 5. Rankine cycle with one regenerative stage.

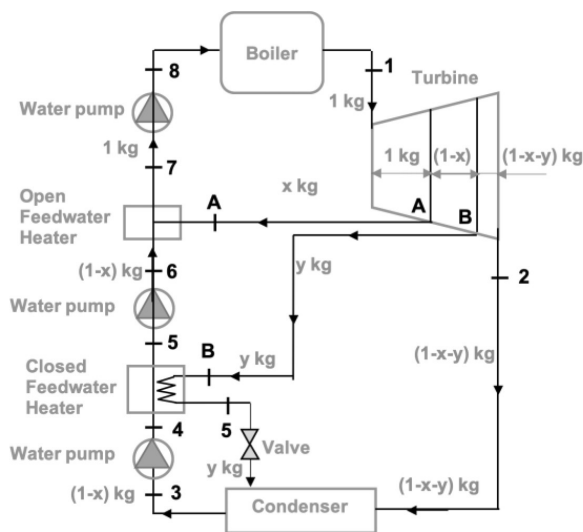


Fig. 6. Rankine cycle with two regenerative stages.

symbology. For this, the following explanation is provided regarding the necessity of measuring thermodynamic variables: “the only thermodynamic variables that can be measured are pressure and temperature. The power plant can be controlled with these two thermodynamic variables plus the

measurement of the water mass flow. There are different types of thermometers; for example, some are used to obtain an actual reading in situ, and others send a digital signal to a general control panel.” Below are the questions related to this section. To solve them, it is necessary to refer to the diagram in Fig. 2:

- **Q<sub>10\_1</sub>**. Find how many temperature measurement points are.
- **Q<sub>10\_2</sub>**. Find how many pressure measurement points are.
- **Q<sub>10\_3</sub>**. Find how many flow measurement points are.

The answer is 5, 3, and 1, respectively, which are not many points, and the student must note this since the rest of the values of the power plant can be obtained from the thermodynamic analysis.

### 3.3 Calculation Questions

To solve the questions related to this section, firstly, the student is provided with the data of a series of points in a simplified diagram of the thermal power plant. The data are shown in Table 2, and Fig. 7.b illustrates the points to which this table refers. Fig. 7.a is a simplified version of the general scheme of the thermal power plant (Fig. 2) in which only the main flows appear. The values in Table 2 are not actual data from the “La Loma” power plant; it is a collection of data designed by the authors that provide a power of about 16 MW. Furthermore, ten different data collections were developed on the online platform to personalize the project for each student.

- Q<sub>11</sub>**. The student must determine the thermodynamic properties of the significant points of the cycle, for which the following indications are given:

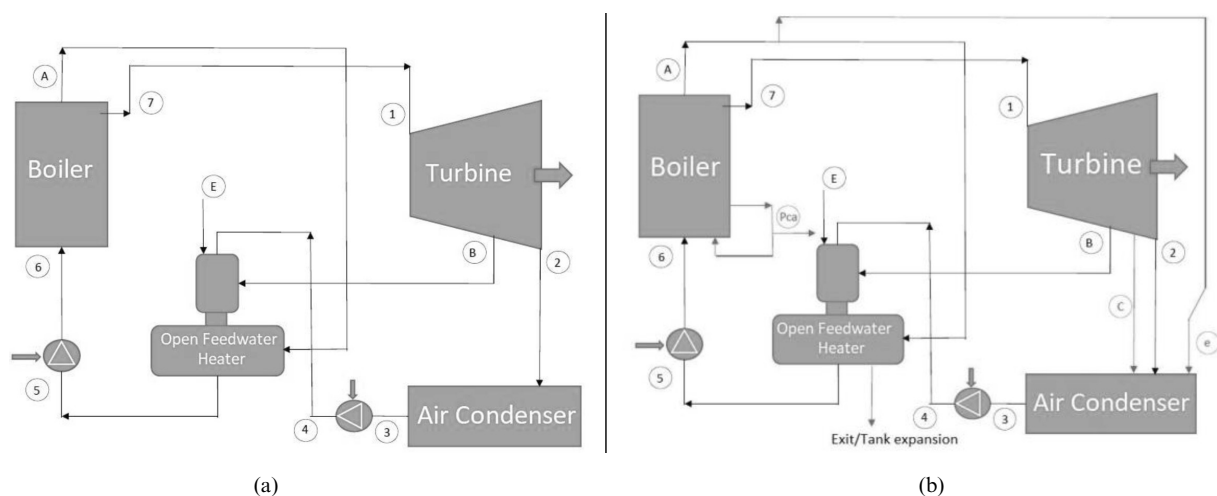


Fig. 7. Simplified schemes of the elements of the power plant: (a) main flows, (b) secondary flows added.

**Table 2.** Input data for the thermodynamic analysis

Point	P [bar]	T [°C]	Moisture content (%)
Ambient_(0)	1	15	
System input_(E)	4	15	1.91%
Turbine input_(1)	76	520	96.73%
Regeneration_(B)	4	190	13.36%
Sealing extraction _(C)	1.4		
Turbine output_(2)	0.02		83.22%
Output low pressure pump_(4)	20	18.1	83.86%
Output open feedwater heater_(5)			100.00%
Output high pressure pump_(6)	80	111.7	100.00%
Boiler Extraction_(A)	78	327	0.50%
Boiler exit_(7)	77	530	96.73%
Mass flow [t/h]		52.35	

- “After calculating the properties of points B and B’, where B’ is the same as point B but considering an isentropic process, deduce the isentropic efficiency of the turbine. Use this yield to determine point 2 from 2’ (the same as point 2 but considering an isentropic process).”
- “To obtain the pressure at point 5, consider that it is saturated liquid and use the value of its enthalpy calculated from an energy balance in the open feedwater heater.”
- “The data of the regeneration pressure of sealing “C” will be needed later.”

### 1. Questions about devices efficiency.

After determining the thermodynamic properties of the significant points of the cycle (Fig. 7a), the student is asked to enter the following data calculated from the properties:

- Q<sub>12.1</sub>. Provide the turbine efficiency.
- Q<sub>12.2</sub>. Provide the high-pressure pump efficiency.
- Q<sub>12.2</sub>. Provide the low-pressure pump efficiency.

### 2. Question about extracted steam mass flows.

Now, the student is required to calculate the extracted steam mass flows illustrated in Fig. 7(b), for which the following indications are given:

- “Point C: it is related to the steam extraction in the turbine to seal it in the low steps. To determine its thermodynamic properties, the turbine efficiency previously obtained is used. Remember that the regeneration sealing pressure is available in Table 2.”
- “Point e: represents the steam flow used in the ejector. Consider the same pressure as point A.”
- “Point Pca: corresponds to the purge that, after several cogenerations, ends up in the open exchanger. Consider the same as point A.”

Next, the student is asked to perform the following energy balances and provide some results:

- Q<sub>13.1</sub>. Perform an energy balance in the turbine to obtain the regeneration sealing mass flow rate (kg/s). Provide the result obtained.
- Q<sub>13.2</sub>. Perform an energy balance in the condenser to obtain the steam ejector mass flow rate (kg/s). Provide the result obtained.
- Q<sub>13.3</sub>. Perform an energy balance in the boiler to obtain the purge mass flow rate (kg/s) used for cogeneration. Provide the result obtained.

### 3. Questions about power and thermal efficiencies of the power plant.

At this stage of the project, it is possible for the student to calculate the following parameters:

- Q<sub>14.1</sub>. Turbine power output.
- Q<sub>14.2</sub>. Boiler power input.
- Q<sub>14.3</sub>. Pumps power input.
- Q<sub>14.4</sub>. Cycle thermal efficiency.

A table has been designed on the learning platform for the student to provide these work results.

### 4. Questions about exergy.

Next, the following calculations on exergy are proposed:

- Q<sub>15.1</sub>. Calculate the exergy loss of the turbine, considering that the sealing extraction corresponds to a loss of heat at the temperature determined for point C.
- Q<sub>15.2</sub>. Calculate the exergy lost in the heat exchanger, neglecting the exergy of the flow coming from the cogeneration.
- Q<sub>15.3</sub>. Calculate the exergy lost in the condenser.

The student is requested to provide the calculation results together with the diagrams of the exergetic balance in the turbine, the heat exchanger, and the condenser.

**Table 3.** Results related to thermodynamic properties of the cycle shown in Fig. 7(b)

Point		Mass flow [kg/s]	P [bar]	T [°C]	Enthalpy [kJ/kg]	Entropy [kJ/(kg·K)]	Exergy* [kJ/kg]
Ambient	0	–	1	15	62.96	0.2237	–
System input	E	0.2779	4	15	63.75	0.2237	0.79
Turbine input	1	14.0658	76	520	3451.55	6.8153	1489.22
	B'	–	4	143.63	2705.10	6.8153	–
Regeneration	B	1.9431	4	190	2838.93	7.1235	787.79
	C'	–	1.4	109.32	2525.36	6.8153	–
Sealing extraction	C	0.0214	1.4	109.32	2691.41	7.165	628.32
	2'	–	0.02	17.51	1978.60	6.8153	–
Turbine output	2	12.1013	0.02	17.51	2242.68	7.522	76.72
Condenser output	3	12.1954	0.02	17.51	73.50	0.2606	–0.09
	4'	–	20	–	75.50	0.2606	–
Low-pressure pump output	4	12.1954	20	18.1	75.96	0.2690	–0.05
Heat exchanger output	5	14.5417	1.4	109.32	458.81	1.4109	53.76
	6'	–	80	–	466.66	1.4109	–
High-pressure pump output	6	14.5417	80	111.7	468.52	1.4109	63.47
Boiler purge	Pca	0.4032	78	327	2908.24	6.0094	1178.13
Boiler Extraction	A	0.0727	78	327	2908.24	6.0094	1178.13
Boiler output	7	14.0658	77	530	3474.50	6.8380	1505.63
Steam ejector	e	0.0727	78	327	2908.24	6.01	1178.13

\* Respect to the ambient.

### 5. Questions about fuel consumption

This analysis is important to quantify the daily biomass demand. The question proposed is shown below:

**Q<sub>16.1</sub>.** Considering that the power plant uses “orujillo” as fuel in the boiler and that the properties of this fuel are: a lower heating value of 3700 kcal/kg, a humidity of 12%, and a density of 615 kg/m<sup>3</sup>; calculate the volume in m<sup>3</sup> of daily consumption of “orujillo” by the plant under study.

## 4. Results and Discussion

### 4.1 Project Results

Each student handled different data from their peers to solve the project. Tables 3 and 4 summarize the results of a reference case. Since the learning platform allows the students to check the results of their peers, they were asked to observe how the variation of the input data (design parameters) influences critical results, such as thermal efficiency.

Checking the students' results obtained in this experience, we concluded that they have understood how crucial it is to calculate energy efficiency to determine if energy resources are being used efficiently. It was observed that the students knew the importance of calculating the thermal efficiency of the power plant.

Another significant target for the students is to

see how, in each case, different starting pressures or temperatures result in powers that fluctuate upwards or downwards concerning the reference power of 16 MW and how all this influences the amount of daily fuel required by the power plant.

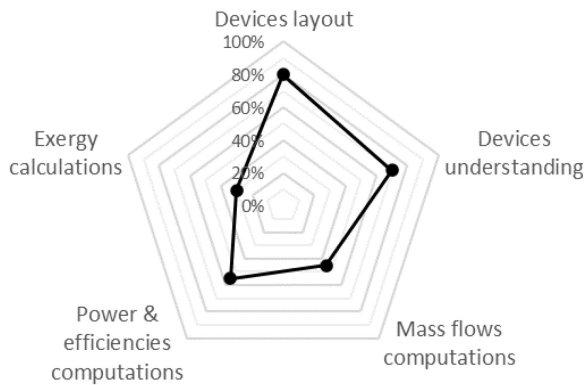
### 4.2 Learning Results and Discussion

It is simple to configure the educational platform to provide the percentage of students that correctly solve each activity, mark distribution, time spent in each activity and tries accomplished (in the self-learning stage). To assess the learning outcomes of this experience, we consider the percentage of

**Table 4.** Results for each device of the power plant shown Fig. 2

Parameter	Result
Turbine efficiency (%)	82.07
Low-pressure pump efficiency (%)	81.32
High-pressure pump efficiency (%)	81.65
Turbine heat loss (kW)	9.59
Power from the turbine (kW)	<b>15835</b>
Power need by the low-pressure pump (kW)	30
Power need by the high-pressure pump (kW)	141.2
Cycle net power (kW)	15664
Boiler power input (kW)	43442
Cycle efficiency (%)	<b>36.06</b>
Turbine efficiency (%)	79.15
Exergy efficiency of the heat exchanger (%)	44.57
Biomass consumption (orujillo) [t/day]	<b>242.6</b>





**Fig. 8.** Measurement of the student's ability to analyze an actual thermal power plant.

correct answers as the student's ability to understand a concept or the student's skill to accomplish a computation trained in one of the proposed activities.

In Fig. 8, it can be seen that students find those activities related to computation more difficult, and the exergy-related calculations are the most complex for them, with only 20% correct answers. On the other hand, results show that students can easily identify facilities and components of the actual system (the thermal power plant in this experience) and obtain most of the necessary energy parameters needed to manage the system.

In general, the approach can be extended or adapted to train engineering concepts and computation procedures related to complex systems using the same learning platform tools: mainly quizzes with different types of questions and grade applications for collecting results data.

## 5. Conclusions

This work describes how to train thermal engineering concepts through a PjBL aided by a learning platform. Substituting the teaching goal, revisited

in the following paragraph, for any other topic that needs to understand and compute engineering parameters, the presented experience aims to help interested readers implement similar PjBL experiences identifying helpful educational learning platform tools such as self-corrected quizzes based on drag and drop onto an image, multichoice and calculated questions, and finally, statistical tools for results analysis.

The educational goal presented in this work is to facilitate the student to fill the gap between the theory and the actual applications by simplifying the real cases and comparing them with the theoretical cases studied. The key is knowing how to recognize the equipment and diagrams analyzed in university courses in actual installations. Another important issue is determining what data is needed to carry out thermodynamic calculations, which, usually, are not as many as they might seem at first. After measuring these variables, the engineer will be able to understand and verify the operation of the entire thermal power plant.

Understanding the installation from a thermodynamic point of view will greatly help predict results and organize operations at partial loads or start-ups. An engineer needs these skills to solve problems that other workers in the thermal power plant could not solve.

The analysis of the results collected thanks to the learning platform after applying this project-based learning shows that students are able to understand the components of a thermal power plant shown on a scheme corresponding to a real installation and obtain most of the necessary energy parameters needed to manage the plant by themselves. However, exergy calculations seem challenging for students since most did not provide correct answers in this activity.

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