

Article

Power Plants, Steam and Gas Turbines WebQuest

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Abstract: A WebQuest is an Internet-based and inquiry-oriented learning activity. The aim of this work is to outline the creation of a WebQuest entitled “Power Generation Plants: Steam and Gas Turbines.” This is one of the topics covered in the course “Thermodynamics and Heat Transfer,” which is offered in the second year of Mechanical Engineering at the Defense University Center at the Naval Academy in Vigo, Spain. While participating in the activity, students will be divided into groups of no more than 10 for seminars. The groups will create PowerPoint presentations that include all of the analyzed aspects. The topics to be discussed during the workshop on power plant turbines are the: (1) principles of operation; (2) processes involved; (3) advantages and disadvantages; (4) efficiency; (5) combined cycle; and (6) transversal competences, such as teamwork, oral and written presentations, and analysis and synthesis of information. This paper presents the use of Google Sites as a guide to the WebQuest so that students can access all information online, including instructions, summaries, resources, and information on qualifications.

Keywords: WebQuest; engineering; gas turbine; steam turbine; power plants; Google sites

1. Introduction

Since 2010, the main objective of the Bologna Process has been to create a European Higher Education Area to standardize academic degrees and quality standards in European countries. Since the Bologna Declaration, European countries have adapted their educational strategies to common parameters, whereby students spend more time on personal work, and teachers dedicate less time to lectures. Therefore, new teaching methodologies that adapt to these strategies should be created to improve education [1,2].

Especially since the introduction of digital technology, information technology has changed the way we teach and learn [3]. Information and communication technologies (ICTs) are becoming increasingly widespread at different levels of education. Many teachers find that these tools are useful not only to improve their own skills and knowledge, but also to take their classes to a higher level that engages most students [4].

ICT is used to improve the learning process at universities. Therefore, in order to meet the goals of the Bologna Process, Spanish universities are implementing more and more virtual platforms as an educational support and learning tool for classes.

The World Wide Web has brought new possibilities for education and learning. A WebQuest is an example of how activities can be designed to integrate the use of the Web. A WebQuest can be defined as an activity in which some or all of the information with which learners interact is available on the Internet [5].

WebQuests began to appear in 1995 [6]; although the idea of the Web was established in 1989, the real growth of the World Wide Web occurred later. WebQuests, however, caught people's interest from the very beginning. Their aim is to promote learning through inquiry, reading, analysis and synthesis of information found on the web [7]. Among the tools used to design a WebQuest activity are numerous online and offline options. In this paper, we demonstrate how we developed the use of an online script for a WebQuest using Google tools, particularly Google Sites [8,9].

This activity also promotes collaborative learning by encouraging students to work together in small groups. As an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product [10,11], collaborative learning (CL) is very beneficial to students [12].

This paper describes a WebQuest about power plants and gas and steam turbines. It has been designed to enhance the learning process and to promote active and autonomous student learning at the Defense University Center of the Naval Academy of the University of Vigo.

2. WebQuest Composition

A WebQuest includes six stages: (a) introduction: general information about the topic that the learners pursue; (b) task: a general description of what students are required to do; (c) sources: list of information resources, mostly websites, for students to complete the task; (d) description of the process for students to follow step by step; (e) evaluation: evaluating criteria for students' work; and (f) conclusion: a briefing of the experience, including a reminder to students of what they learned and opportunities to increase or disseminate the activity.

WebQuests can be conducted either as a short-term project in one or two class periods, or over the long term, lasting more than one week. WebQuests usually require students to work in groups. They can be designed within a single academic discipline, or they can be interdisciplinary.

3. Methodology

Generation power plants are facilities that are used to transform primary sources of energy, such as thermal energy, wind energy, and so on, into electricity. This activity aims to study the transformation of thermal energy into electrical energy and focuses on the transformation processes that use steam turbines, gas turbines, or both.

The course's aim is to introduce the concepts of power generation by steam and gas turbine power plants while developing the students' cognitive processes. For this reason, the authors decided to implement specific learning methods to prepare the lesson on "Power Plants." One of these methods is a WebQuest.

Participation in this activity will take place over a full semester. It will be presented to students on the first day of class when the teacher first explains the subject.

The WebQuest is divided into five sections: an introduction to the WebQuest, a task to explore power plants, a list of resources proposed by the teacher for the teams of students, a description of the process with detailed information on performing the tasks and the time to be spent on them and, finally, the evaluation of the activity.

The objectives of this WebQuest are listed below (Table 1).

Table 1. The specific aims of our WebQuest.

Aims of the WebQuest: Power Generation Plants: Steam and Gas Turbines
1. Operating principles of gas turbines and steam turbines. Types of fuels, working fluids.
2. Main processes involved in steam plants and gas plants.
3. Advantages and disadvantages of gas turbines and steam turbines; their main differences.
4. Gas turbines and steam turbines from an efficiency point of view.
5. Combined cycle plants; basic operation and schema.

The WebQuest requires students to develop transversal competencies, such as working in teams, completing oral and written presentations, and analyzing and synthesizing information. The resources include websites that allow students to find the information necessary to answering questions about power plants. The resources are shown in the table below (Table 2).

Table 2. Resources.

Resources
1. http://es.wikipedia.org/wiki/Generaci%C3%B3n_de_energ%C3%ADa [13]
2. http://ocw.unican.es/enseanzas-tecnicas/fisica-y-tecnologia-energetica/recursos/09-turbinas.pdf [14]
3. http://es.wikipedia.org/wiki/Ciclo_combinado [15]

3.1. Activity Development

To perform the WebQuest activity, the students are assigned to groups of ten that attend a one-hour class. At the beginning of the activity, each student conducts an individual search for information and attempts to answer questions to achieve the aims of using the information provided in the resources, as well as other web resources.

A template is given to the students to facilitate the completion of the WebQuest. This template is to be handed in to the teacher at the end of the class.

After the first quarter of the allotted time, two groups will be formed with five people each. Each group will provide common information obtained in the first stage. A PowerPoint template will be given to each group so that they can present the various topics orally. Each group will have a quarter of the time of the activity to prepare this presentation and develop information.

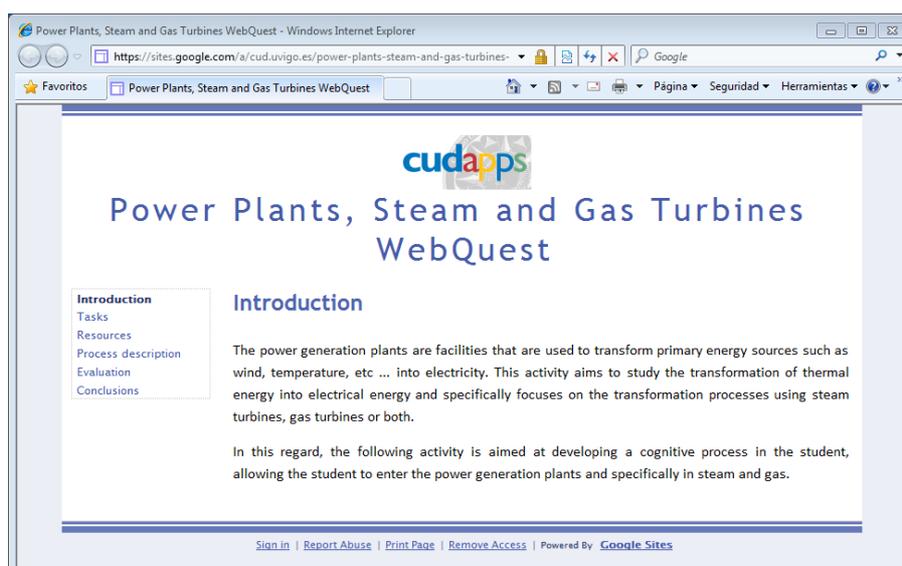
The last half of the activity will be dedicated to the exposition of the groups' presentations. Each group will have a maximum of eight minutes to develop an exposition in which all group members will present part of the information.

The last two minutes of the presentation, a question-answer period, gives the teacher the chance to verify that the aims of the WebQuest have been achieved.

3.2. Google Sites Used for the Activity Guide

To facilitate the students' completion of the activity, a Google Site [16] (Figure 1) will be prepared with information on the activity. The site will contain information on every step of the activity. This site will be the main page in the browser of the students' computers.

Figure 1. Activity guide in Google Sites.



Using Google Sites helps students to avoid interruptions during the development of the activity. The teacher can refer to different parts of the WebQuest, and the students will always have this information available. As seen in Figure 2, the Google Site provides quick access to different parts of the WebQuest (Introduction, Tasks, Resources, Process Description, Evaluation and Conclusions).

Figure 2. Menu presenting the different aspects of WebQuest.



3.3. Evaluation Results

The students’ work will be evaluated at different levels. Criteria will be established for oral presentations and for written assignments. The students’ work will be assessed based on the quality of information, the visual aspects of presentations, oral capacity and how well the students work in teams.

Table 3. Assessment criteria.

Aspects to Evaluate	Max. 100%	× 0.2	× 0.6	× 1
Content of individual document	35%	Not very prepared and does not include the areas identified	Document prepared but does not include all aspects of the work proposed	The information matches the proposed work
Oral presentation: individual assessment	35%	Presentation only to the teacher, regardless of the audience	Only talking to part of audience or to the teacher	Talking loudly and clearly to all audiences
Oral presentation: evaluation of group	30%	Repeat content between presenters; Presentation disorganized and incomplete	Lack of continuity in changing presenters; Complete presentation but with errors	Complete content with continuity; Presentation organized and complete

Table 3 with the evaluation criteria is also included on the Google Site so that students can see the criteria for their evaluation and therefore act accordingly.

3.4. Limitations of Research Design

This activity is deployed at the very beginning of their introduction to the topic. The students have not received any prior lectures regarding steam and gas turbines. This is thus a relatively short amount of time to develop the activity. An exhaustive script is therefore given to the students to avoid this problem.

To verify the effectiveness of the proposed teaching method, its results are compared with those obtained by another method in the same subject. This method is problem-solving homework. There could be some problems that have to be considered when comparing two activities as different as the WebQuest and homework.

Subjective components could be easily introduced in the evaluation of the WebQuest but in the homework this subjective component is more difficult to be introduced.

4. Application of the WebQuest

The previously designed WebQuest was applied in the first semester of the 2011–2012 academic year for the Mechanical Engineering degree offered at the Defense University Center of the University of Vigo, in a second-year “Thermodynamics and Heat Transfer” course. This course had 70 enrolled students with mandatory school attendance (except for sick leave, guard duty or special leave). This activity was attended by 68 students.

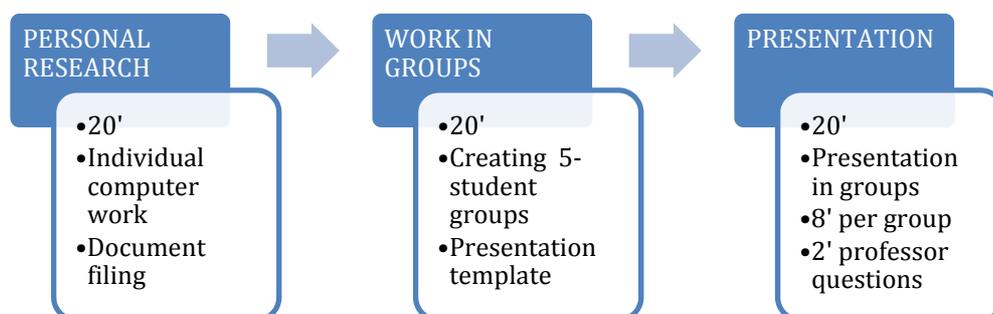
4.1. Execution of the Activity

To perform the activity, students were assigned into groups of ten and attended a one-hour seminar. At the beginning of the activity, each student conducted an individual search for information and attempted to answer questions to achieve various goals. The length of this individual search was estimated to be 20 minutes.

After performing this search individually, the ten students were divided into two groups of five students. They were given another 20 minutes to share what they found online and to prepare a PowerPoint presentation to be delivered jointly. During this time, the process was supervised by the teacher, who monitored the students’ activity and provided advice and answers to their questions.

The last 20 minutes of the class were dedicated to presentations by each group. A maximum of 8 minutes was allotted to each group presentation, leaving a couple of minutes for questions by the teacher at the end. The sequence of the groups was determined randomly. All group members presented part of the material. The distribution of activities can be seen in the following scheme in Figure 3.

Figure 3. WebQuest process.



The activity was conducted in a computer lab that had projection capabilities.

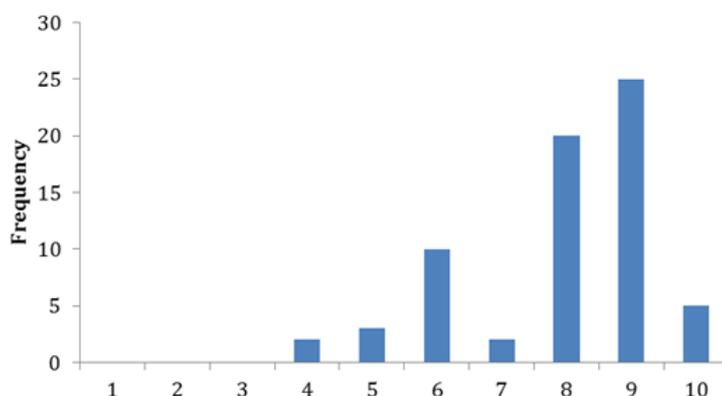
4.2. Results

At the end of the activity, the teacher collected each student’s individual document, saved the group presentation and took notes during the presentations, taking into account individual and collective impressions. The teacher then applied the evaluation criteria to this information.

The analysis of the results showed that the average score for all students was 7.60 out of 10; the highest score was 10, and the lowest was 3.4. The analysis of the results by groups showed that the best group received average scores of 9.16, and the worst one received average scores of 4.80.

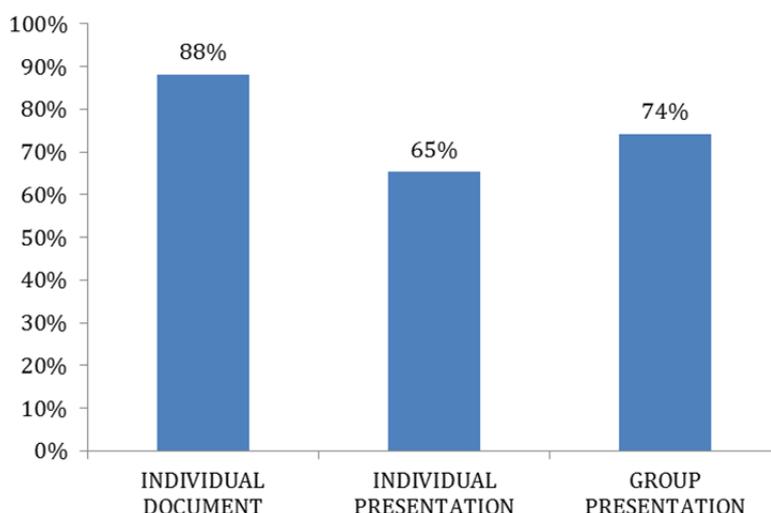
The distribution of marks is shown in a histogram in Figure 4.

Figure 4. WebQuest marks distribution.



If we analyze the sections according to the evaluation criteria, we find that in the single document section, an average of 88% was achieved. In the individual presentation section, an average of 65% was achieved, and in the group presentation section, an average of 74% was achieved, as shown in Figure 5.

Figure 5. Goal achievements.



Students had the most difficulties in the individual presentation, and the highest scores were obtained on the individual documents.

4.3. Comparison with Traditional Methods

To verify the effectiveness of the proposed teaching method, its results are compared with those obtained by another method in the same subject. The other method consists of performing an exercise on the same topic. The students are asked to individually and independently perform this exercise and are given one week to do so. Homework is given to the teacher for evaluation.

The histogram of marks for this activity is shown in Figure 6.

Figure 6. Homework mark distribution.

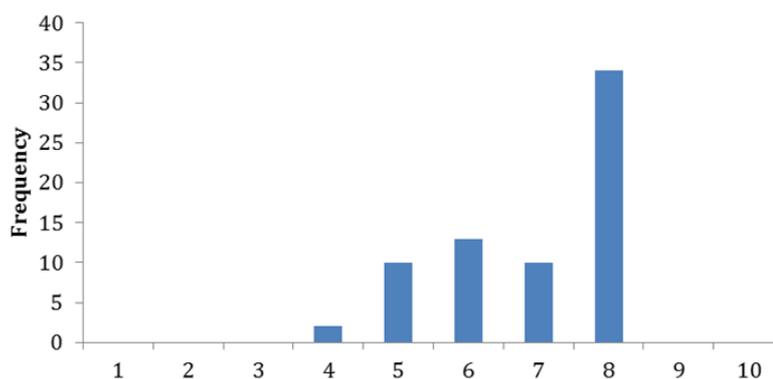


Table 4 shows the comparative results of both tests.

Table 4. Comparative results.

Activity	Min. mark	Max. mark	Median mark
WebQuest	3.4	10	7.6
Homework	4.0	8.0	6.6

5. Conclusion

In this paper, a WebQuest was designed to be used for the second-year course “Thermodynamics and Heat Transfer.” The authors’ goal is to improve students’ retention, assimilation and understanding through the WebQuest.

The WebQuest is a teaching tool that compels students to worry about acquiring proposed knowledge without “waiting for information to arrive.” The teacher then checks by the end of the course that the students have acquired the outlined knowledge. Although there was initially some skepticism, the student eventually realizes the utility of the activity and how guided and regulated self-study in a predetermined period of time can be quite effective.

The transmitted knowledge is much more likely to be retained than through traditional methods because the student has made a personal effort to read, understand and structure the proposed topics.

The main problem found in developing this activity is that time is too short. At least one hour and a half or a two-hour class is recommended to ensure the students’ assimilation of the contents. This is where improvements for future activities can be made.

The use of Google Sites is presented as a complement to the WebQuest and integrates the guide in the same activity. The main advantages of this method are as follows:

- It facilitates students' access to the contents of the WebQuest, avoiding the use of paper guides.
- Access links are given to students so that they can access the provided information with a single click.
- Students can consult the evaluation criteria at any time, which improves their focus on results.

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