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Case Study: Electrical Engineering Introduction Course Using an Integrated Approach via Group Work Viability Projects

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Abstract

This paper discuss an innovative teaching methodology applied in a University sited in Minas Gerais, Brazil. The main goal is to reduce the dropout rate in Engineering Courses. The Federal University of Itajubá (UNIFEI) offers freshmen students a new perspective about the Electrical Engineering course, showing them the vast possibilities it might lead them. For that, the University uses the course called Introduction to Electrical Engineering, based in the formation of groups focused in the study of the viability of Renewable Energy Sources projects. Differently from the traditional method, where the students are merely “recipients” meant to be filled by the professor¹, the idea is to concede a chance for the pupils, allowing them to guide their researches and activities based on their needs. In this context, a group called Photovoltaic Application in Needy Communities (PANC), from the 2015 class, reached at the end of the period the implantation of the group’s objective: a solar system in a Basic Health Center in Itajubá (MG). The methods applied by the group are discussed in this paper.

Keywords: Academic Education, Different Teaching Methodology, Renewable Energy Sources.

1. Introduction

The Engineering course has extremely high dropout rates. According to a study conducted from 2001 to 2011 by the National Confederation of Industry (CNI [PT]), the average rate of dropout students of Engineering courses in both public and private colleges in the period was around 55.59%. CNI examined these indexes through the Higher Education Census of 2011.¹ Several reasons lead students to drop out of the exact sciences courses: high difficulty in the disciplines, demotivation front adverse situations and misunderstanding of the goals and aspirations of the courses. In order to change this scenario, the course of Electrical Engineering, in Federal University of Itajubá (UNIFEI), is using the chair called Introduction to Electrical Engineering, which focuses in motivating and directing students, presenting them the vast paths Engineering can lead. The course uses a different methodology of teaching, which is based on the formation of groups which are free to choose the most diverse subjects of studies, focusing on Renewable Energy sources. They can use various platforms for publishing the development of their research, such as blogs and pages on social networks. The professor and tutors help groups throughout the course, with theoretical and administrative direction. At the end of the course, students present the results of their work, reporting what were their greatest difficulties and achievements in the period. This method of teaching can be associated with the ideas presented by renowned professors and pedagogues, such as Paulo Freire² and English Professor Clive Staples Lewis³. The authors advocate the idea of integration between the roles of professors and students and try to deconstruct the idea that students are patients in the act of educating, being mere empty containers and teachers, knowledge holders, are the active part in this process, with the task of “deposit” knowledge in these containers. This article presents a group of 10 freshmen which formed PANC (Photovoltaic Application in Needy Communities), in 2015. In the end of the course, the group achieved its purpose: the development of a Solar System in a Basic Health Unit (BHU) in the city of Itajubá (MG-BR).

2. Development

2.1. The Initial Process of Forming Groups

At first, students are asked to split into groups with up to 10 members. So they receive the mission to discuss which issues related to power generation they are more interested or curious to study. Later, the students organize the team and the functions of each member are determined. The basic structure is a manager and a general secretary. However, PANC appointed new positions, such as the Field Research Leader, responsible for formalities with the involved government agencies and the Research Leader, responsible for coordinating the Research Core and for the production of the final documents that were published in blog. With the administrative structure defined, PANC created a schedule to better organize the team activities. Figure 1 presents this schedule.

It is important to note that throughout the course, students are the agents of the progress in their groups, with the teacher and monitors being only “facilitators” of this process, guiding and directing the groups.²

“The students are, or should be, young people who have started to follow the learning on their own initiative, and sticks to another student, not just to be taught, so that there is an exchange of knowledge. From the beginning students should be colleagues (...) thinking

together on the subject to be worked.”³

Researches																
1 - Solar Energy (Settings and Technology)																
2 - Art Situation																
3 - Applications																
4 - Economic Aspects (Investment, Payback, Comparisons)																
5 - Social Commitment (Field Research)																
6 - Analysis of the Results																
7 - Conclusions																
Timeline: Weeks																
Research	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1																
2																
3																
4																
5																
6																
7																

Figure 1. Activities schedule of PANC.

2.2 Progress Report Platforms

With the groups and the functions of each member clearly defined, the groups were asked to create ways to broadcast the research progress and development of their groups. These platforms could be pages on social networking, sites or blogs. PANC created a blog where all the weekly meetings and research progresses were published. Furthermore, there was the creation of a website to present the team members, composed of a small curriculum in addition to the presentation of the central proposal of the team. To keep the blog more active and visually attractive, a section called “Off-topic” was created: a weekly publication that includes recent news on the topic of “Renewable Energy Sources”. Figure 2 illustrates the distribution of PANC’s blog’s posts.

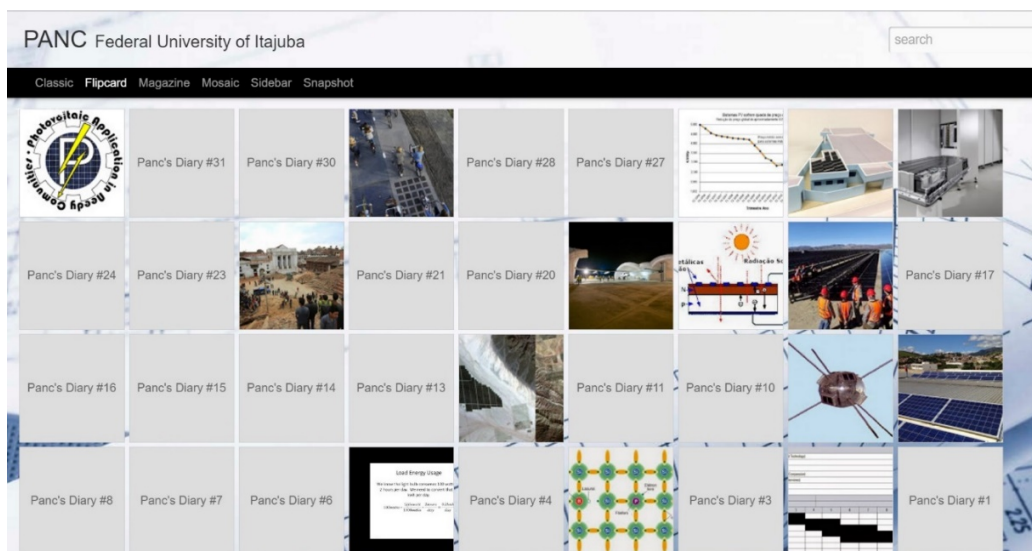


Figure 2. PANC’s publications on blog.

2.3 Preparation of Research

After the basic structure of the teams and the creation of the publishing platform, the groups had freedom to guide their own research as needed. PANC developed research holistically, that is, all members participated in the research. The members were responsible for the theoretical foundation of their research, although the group has set a starting point: the article Engineering Manual for Photovoltaic Systems⁴. There was a refinement of ideas until the final publication was made. In other words, all members performed their activities and published in a shared folder on Dropbox®. Later, the 10 surveys were collected by so-called Research Core, which was a rotating group of 3 or 4 members, depending on the theme. This core performed a filtering of ideas and each member of it had to develop a new document with summarized content. These surveys, then, were again published in the shared folder of the group. Finally, the Research Leader filters the researches published by the Research Core and produces a single from those. The archive built by the Research Leader had the name “Final Research”. This document was formatted and published on the blog. Figure 3 illustrates how the research filters used to work in PANC.

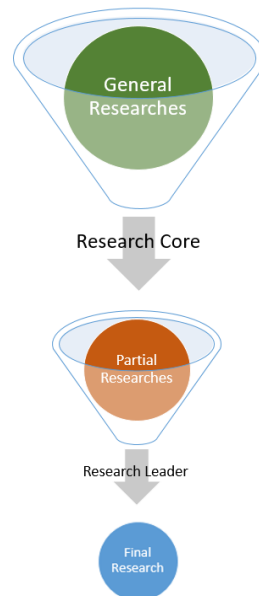


Figure 3. Diagram of Research Filtration Process of PANC.

There was an integration of the knowledge obtained from the course Introduction to Electrical Engineering and others of the same period, such as Expression and Communication discipline, which is responsible for the basic instruction about Academic Rules in texts and productions. Thus, although the chosen blog platform limited formatting text, the PANC sought to make the publications with the highest possible fidelity to the formal criteria.

To sustain the theoretical data in the polls scheduled by the team, various contents have been suggested by the professor. These new materials were placed in another section of the shared folder by the team, named “Parallel Researches”. The Parallel Researches were, once again, performed by the whole group, but were not submitted to the filtering process of ideas previously mentioned. They were generally embedded in planned research, directly

or indirectly. Eventually, when they could not be attached to a research theme, they were published separately.

2.4 Tools and Administrative Methods

In order to maintain greater control over the activities of the group, PANC has created various mechanisms, such that: Meetings based on pre-selected topics, to optimize the time of each member and perform checks of weekly tasks; The use of Feedback and Attendance Spreadsheets, where all activities were evaluated and the presence of each member in the meetings was recorded; Using a shared folder on Dropbox®, which included all the research, meeting topics, spreadsheets and files that the members consider interesting to share; A Behavior's Conduct of all members. This regulation had compensative character, that is, when one member failed to attend a meeting, not delivered an activity or left to be desired in some task, the group directed the member to produce a parallel survey to complement the planned research.

2.5 Design Support Tools

Several ideas for the final presentation were contemplated in the group. The team sought to approach all proposals that add value to the project, so that members feel represented in their suggestions and remained motivated, in order. Among the most notorious team ideas, there is the model of the Basic Health Unit. The proposal was to have a physical model, faithful to reality, to represent the group's study object. For the development of the model, the group had to raise money through raffles. Figure 4 illustrates the result obtained by the staff in relation to the model.

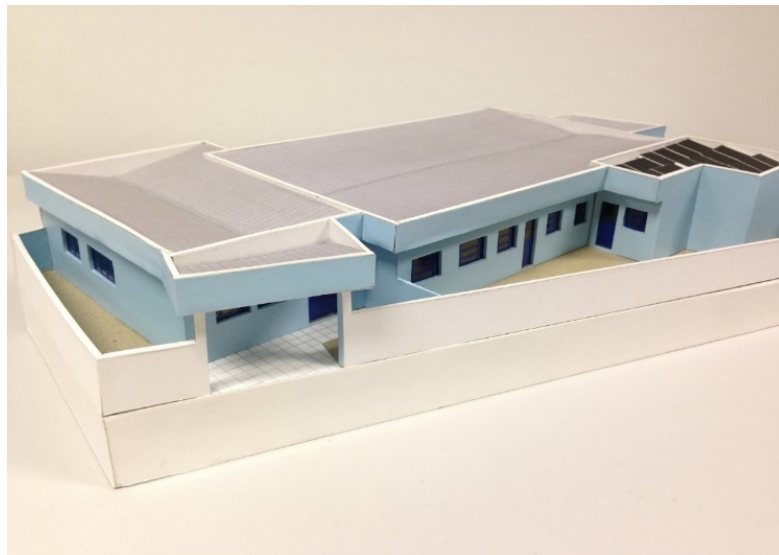


Figure 4. Model created by PANC that illustrates the Basic Health Unit (UBS) of Santa Rosa's Neighborhood.

The group also worked on creating a logo. Inspired by the logo of the University, the result is shown in Figure 5.



Figure 5. Logo developed by the members of the PANC.

2.6 Final Presentation

At the end of the course, the groups should show their results and conclusions as well as the challenges and difficulties they had during the course. PANC used the space for an expository presentation. Thus, a slide was created which included all the issues of the group, for example: the theme chosen by the team (photovoltaic); the group's motivation; the project's objectives; the reasons why the photovoltaic generation is feasible in the locality of the study object; the administrative methodology used by the group; the solar system sizing and expectations for the project. The process of creating the slide and the final presentation of PANC was a cautious process. A group of four members (Manager, General Secretary, Research Leader and Field Research Leader) was selected to create the slide. These four members were responsible for performing the process, as all assisted the group with comments and suggestions. Likewise, the final presentation was combined. In the weeks that preceded the end of the course, the group began to rehearse the presentation. A spreadsheet was created with several criteria for non-speakers members so they could evaluate the presentations, these criteria encompassed: Content Knowledge, Resourcefulness, Diction, Conjectural Organization, regarding the time and clarity. It is important again to emphasize the integration between disciplines in the period. The group used the content presented by the discipline Communication and Expression on the creation of slides to optimize space and the development of ideas in the final presentation.

3. Object of Study: Basic Health Uni (BHU)

After a few weeks of the creation of PANC, came the possibility to study the feasibility of implementing the team's efforts in a specific location: the neighborhood of the Basic Health Unit Santa Rosa, in the city of Itajubá (MG), which was closed for renovation and expansion. From then on, the whole focus of the research was given to this locality. Therefore, the team created the position of Field Research Leader, who is in charge of the responsibilities regarding the negotiations with the government agencies involved in the administration of the health center. With the support of government agencies, the team went on to examine the concepts of the energy needs of BHU after the reforms, based on the energy of the local consumption in 2013. In addition, using the site plans, it was decided where the photovoltaic modules would be positioned, improving the development of the object of study's model. Once the design was done, the group was notified that the project would be financed and the solar system studied by the group would be deployed. Table 1 shows the results of sizing.

Table 1. Solar System Sizing of UBS⁵.

Expected Potency [kW]	4
Potency per module [W]	250
Number of Panels	16
Build Area [m^2]	286,99
Chosen Area for Implantation [m^2]	31,5
Cost of Modules 250W [R\$]	13572,64

The implementation of the PANC's photovoltaic system was only possible due to funding from the National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq) for projects focused on Smart Grid Technologies.

4. Conclusions

It is vital to plan and apply diverse teaching methods. The initiative of the Federal University of Itajubá, due to the high dropout rate problem in exact courses, in using the subject Introduction to Electrical Engineering to motivate and increase the knowledge of students about the Engineering profession's aspirations and atmosphere has proved valid, since it gave possibilities for projects such as PANC happen. The classical teaching method, where students are only patients and receptors in the act of educating, and only the considerations made by the professor are weighted, inhibits students to develop academically and professionally, since the pupil is already able to search knowledge on his own initiative¹. The results of PANC project are diverse: the members learned how to run a group, how to deal with financial issues, how to plan an idea and most importantly, learned Engineering practical way. Not only that, the PANC was a project with social commitment, since the location where the solar system was implemented is a poor neighborhood. One of the project's premises was to bring investment to the site, resulting in a possible improvement in the neighborhood conditions. As was said, the PANC reached at the end of the course, the realization of the project worked throughout the period. After many bureaucratic events, all documents required for the installation were signed. By the end of the first half of 2016, the solar system will be up and running in BHU Santa Rosa. Finally, the impression that the discipline left in the group's students is that "We can do this, we are able to!". The growth,

both as citizens and as professionals, in “PANCers” was immense. And the experience of being part of such a noble and impressive project that impacts the life of a group of people in need will be in everyone’s memory forever. Figure 6 shows PANC in the end of the project.



Photograph 1. Members that compose PANC.

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