Alive Engineering Education

Integrating and Innovating Engineering Education in Favor of Society

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We dedicate this work to all those people that, directly or indirectly, have contributed to make this book come true.

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Preface

This book brings experiences that, rather than being an example, serve as a provocation. Although Engineering degrees are widely recognized for content density and for requiring a lot of dedication from students to complete them, are these enough to form Engineers capable of performing their duties in the Society? Are the graduates of the Engineering courses prepared to work in an increasingly competitive and innovation-oriented market?

The answers to those questions should be sought even during the training of the students if we assess what students are effectively able to do with the training already received. Another concern must be the development of professional skills at each study year. Besides technical competence, is there stimulus for creativity and capacity building for innovation?

The works collected in this book reveal how imperative it is to gradually give students opportunities to express their skills and abilities in the face of real world problems. Active methodologies and the use of new technologies present themselves as efficient ways of bringing these demands into the classroom, but extension activities bring students closer to society and impose challenges that motivate them. Experience has shown that innovative solutions to society's demands arise from those challenges, often with a direct impact on quality of life and social promotion.

We hope that the accounts of this book will enrich and raise awareness for new paradigms of formation with positive results for economic and social development.

Rodrigo Pinto Lemos

CHAPTER 1

University Refrigerator: Learn How to Store Food Efficiently

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Abstract: This paper presents the process of creating the board game developed in the semester 2017/2 in the Logistics Discipline offered by the "Escola de Engenharia Elétrica Mecânica e de Computação" (EMC) of the "Universidade Federal de Goiás" (UFG). The game was named University refrigerator "GelU", inspired by famous games like Game of Life and Monopoly. The game presents as a logical element the principles of storage presented in the menu of the Discipline of Logistics allied to elements of mathematics and logistics. The objective of the game is to use the concepts of gamification to teach in a playful way the importance of logistics in the food storage inside the refrigerator, using mathematical and financial calculation, through the interaction between the users and the constituent elements of the game. As a playful narrative, players - University students - share the same refrigerator to apply mathematical, strategy and logic calculations to efficiently store food, each one receives at the beginning of the game the products to be stored, all represented by game cards. The board presents houses designed for each of the four types of food, being the freezer represented by the color blue, fruits/vegetables represented by the color green, cold represented by the yellow color and the shelves represented by the color red. To win the player must store all food and have the highest

efficiency in the end. The efficiency is calculated by the equation (Vgame-card/Vrefrigerator) x 100. The prototype of the game was evaluated and the research revealed that it has systemic vision for 100% of the researched ones. The developed game - GelU - used a playful language to present the logistics to University students.

Keywords: Storage, Board Game, Logistics, Education, Gamification.

1.1 Introduction

Still the great technology evolution that we are experiencing today, which allows for complex electronic games, augmented reality games and mobile applications, board games, popular in the 1960s and 1970s, are still valuable tools[1] for a variety of reasons such as reduced cost, ease of application and independent operation of energy sources.

Several companies and education professionals in the process of training, learning[2] and simulation[3] currently use these games. This concept and known gamification means the use of game elements in mechanics and situations that are not pure entertainment[4]. As for example the language school Yázigi[4] that developed cellular game to encourage the learning of the English language. The Alura digital school that has the Alura Start[5] platform that used game tools to teach programming in a practical way these and other examples of gamification application demonstrate the strength of these tools in the learning process.

This concept is gaining strength nowadays through a consensus among educators and researchers in the education of the efficiency of the game. For stimulate learning in a playful way, helping in the concentration and engagement of children and adolescents. Such as the doctor in neurology Paulo Henrique Ferreira Bertolucci, affirm that board games bring countless benefits to the brain and furthermore promote learning[6], biologist and anthropologist Gregory Bateson once stated that gaming is the best means of integrating into people regardless of social class, culture or generation.

The success of gamification in the learning process is due in part to the enormous difficulty of keeping young people's attention to the study for work training, but these same young people are able to spend hours concentrated in a single game3, thus applied concepts of games in teaching increases the level of concentration is people's engagement.

In this paper, it will be possible to know the process of creation board game "GelU", which tries to transmit through the gamification the theoretical concepts of logistics, transportation and storage learned in the discipline, as regards the concept of storage of goods, besides has elements that encourage players to make decisions, perform mathematical calculations and strategy. The game tries to be simple in design and mechanics and the same attractive for the player, but it does not fail to convey ideas about logistics and storage, which can be used in the home and in the life of the player and that can make a difference in the future.

1.2 Objective

To teach in a playful way the importance of the correct storage of goods/products of the day to day, besides: stimulate mathematical calculation; simulate the financial movement; and stimulate logical reasoning.

1.3 Method

For the construction of the GelU, game was using methodology of Design Thinking, which is a methodology of creative management of the project, with a focus on the user[7]. In addition to favoring the individual creative process[8].

The process was divided into 3 phases. First stage of immersion: which consists of experiencing and deepening the field of action of the project. Second phase Ideation: Idea development process subdivided into Four stages: Desk research: analysis of researches carried out by third parties that contribute to the project. Generative sessions: meetings with the production team to discuss the issues encountered. Brainstorming: generation of ideas presented by the project team. Ideas menu: technical viability study presented ideas. Third phase Execution divided in two steps: Prototyping: creation of prototypes for the project and execution: finalization of the prototype approved after the tests.

The first phase of immersion was studied the main concepts of logistics and elements of construction of games, fundamental points for the execution of the game.

The second phase of ideation, was structured the idea of the game, layout, design of the pieces and other items that later saw turn into the board game "GelU". In the Desk survey was raised research and available works on creating board games and gamification. In the generative sessions were held meetings to generate discursion on the existing models and possible elements that would come to be used in our game. In brainstorming, the team set out the points of view and make suggestions for the design of the project. Finally, in the menu of ideas part of the generated ideas were placed in discourse, the criterion of selection was defined by technical feasibility for execution and consonance with the elements of logistics. So came up with two ideas for game creation. 1st to food storage, 2nd cargo carrier. After applying the menu of ideas it was defined that the 1st idea of the game would be the most viable and most suitable for execution.

The third development phase was the prototype creation of the game, called University Cooler, "GelU", in the prototype was created a board, and the cards developed the rules of gameplay. Students of the discipline of logistics put this prototype to the test in an assessment and the results used to improve the final game.

Finally the game was finalized. with 1 board with 38 houses, 28 representing parts of the “refrigerator”, a beginning, two fields of benefits where the player makes more money, a frozen house, in which the player when falling remains a round without play and 6 “Interrogation” houses in which the player must withdraw a question card and may have a benefit or punishment depending on the luck.

1.4 Results

The survey revealed that 100% of the respondents consider that the game has totally systemic vision, partially 0% and 0% none. 80% of respondents consider that the game offers totally stimuli for decision-making, 0% partially and 20% none. The rules are very clear for 100% of respondents, 0% consider partially and 0% no clarity. The design is very innovative for 40% of respondents, 40% partially and 40% considered without any innovation. 20% of respondents consider that the game has total harmony between its elements, 40% partial and 40% none. The theoretical foundations are totally intrinsic to 80% of respondents, 20% partially and 0% none. 0% of those surveyed consider much unpublished the theme of the game, 60% partially and 40% no novelty.

1.5 Conclusions

The game "GelU" betting on the simplicity and focus on a punctual storage problem and with educational sub contexts presented great acceptance among the evaluations and showed to have good gameplay and attractiveness. Elements collaborated to achieve the proposed objectives of teaching basic principles on storage, encourage mathematical and financial calculation and learning in a playful way.

Players were able to use the mechanics proposed by the game to store the products correctly, learned examples of products belonging to each category presented and the best place to store and made possible the mathematical and financial calculation used to make purchases and calculation of space required for each product and the level of efficiency obtained.

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CHAPTER 2

Board Games: Evaluation of The Game Development Methodology in Engineering

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Abstract: The game methodology is used in education in various areas to stimulate creativity, concentration, reasoning, abstraction and other cognitive aspects. This work presents the results of the evaluation of the methodology of teaching - with games - used in 2017 2 in the offer of the subjects of Administration and Logistics in the Electrical Engineering course of the Federal University of Goiás. stimulated by the teacher on the first day of class, being presented the work schedule of the steps to be carried out until the final delivery of the

prototype. The subjects were chosen by teams with up to 3 students regularly enrolled in the course, but all subjects should be included in the course syllabus and should be included in the training course emphasis. This research is exploratory and the data collection was performed with a questionnaire applied to the authors of the games after the end of the semester, non-probabilistic and with intentional sample. The survey revealed that 100% of respondents believe that game development provides a systemic view and encourages players to make decisions. 67% of respondents consider that the clarity of the rules allows a greater understanding of the game and that design is an instrument of innovation. The use of this methodological proposal enabled the teacher to teach in a way that arouses interest in the subject topics offered in the course and increase the learning of the contents by the students.

Keywords: Education, Engineering, Board Game, Playful, Methodology.

2.1 Introduction

In the creation of the games each author seeks different alternatives, for Dedopulos (2013) [1] in compiling his book he used "historical elements in the same way that a piggy bank treats a box of jewels - I collected names, places and other fragmented glosses of random facts, , forming a nest for my games. In other words, it is safe to assume that I have taken many liberties with anything that does not even seem like concrete information".

Games are always part of our culture as a social practice [2]. In order to evaluate the delivery of value included in each of the board games (prototypes developed in 2017), seven criteria were used: 1. Integration of items; 2. Level of stimulus for decision making; 3. Clarity of rules; 4. Innovative design; 5. Connection between the game and reality; 6. Intrinsic theoretical foundations; 7. Ineditism of the theme [3].

The methodology developed in the disciplines - centered on the creation of traditional board games - was developed using the contents discussed in the subject matter, which was offered in 2017, in the disciplines of Engineering graduation at the Federal University of Goiás.

The methodological challenge was to create an innovative environment aiming to facilitate the learning of the enrolled ones, fact that the creation of games appeared quickly like first option. Among the various possibilities of games was chosen the option of board games for greater ease and speed for their creation.

For Cerbasi (2012)[4] the games were specially designed so that you train the mind in a specific way, increasing its potential and helping you to analyze the problems of different angles, always with a new look.

2.2 Purpose/Hypothesis

To analyze the results of game development as a learning tool, by providing a new methodology from the conception, development, execution and application of games using the contents covered in the teaching plan of the disciplines, and to evaluate the efficiency of learning in the dynamic context and challenging the final delivery of games that were tested during the execution of the discipline.

2.3 Methodology

Research exploratory type, quantitative and documentary[5-6]. As an instrument of data collection, an observation script was used with 7 closed questions with the scale of response in 3 levels (total - weight 3, partial - weight 2 and none - weight 1).

The data collection was performed with 3 games developed (intentional and non-probabilistic sample) in the subjects offered in 2017/2 in the Electrical Engineering course of UFG in Goiânia. Bibliographic research was used to substantiate the others[7,8].

2.4 Result

The analysis was performed based on 3 games (total population) in order to evaluate the learning achieved. In each of the prototypes seven criteria were used, namely: 1. Integration of items - (brand, board, rules, parts and others); 2. Level of stimulus for decision making; 3. Clarity of rules; 4. Innovative design; 5. Connection between the game and reality; 6. Intrinsic theoretical foundations; 7. Theme/structure/other novelty - (game has some rarity).

The research revealed that the creation of the games made it possible to DEVELOP a total systemic vision for 100% of respondents, partial to 0% and none to 0% (question 1). The creation of the games ENTIMULATES the players to make a decision was considered 100% total, 0% partial and 0% none (question 2). In the creation of the games the CLARITY of the rules made it possible to better understand the game was total for 67% of them, partial to 33% and none to 0% (question 3). In game design, INNOVATION design was considered total for 67% surveyed, partially for 33% and nothing innovative for 0% (question 4). The survey revealed that the connection of the game with reality was total to 67%, partial to 33% and none to 0% (question 5). The theoretical foundations were totally perceived in 100% of the games, partially perceived in 0% and not perceived in 0%. The research revealed that some aspect of novelty (rarity) was totally presented for 100%, partially for 0% and nothing presented for 0%, according to Figure 2.1.

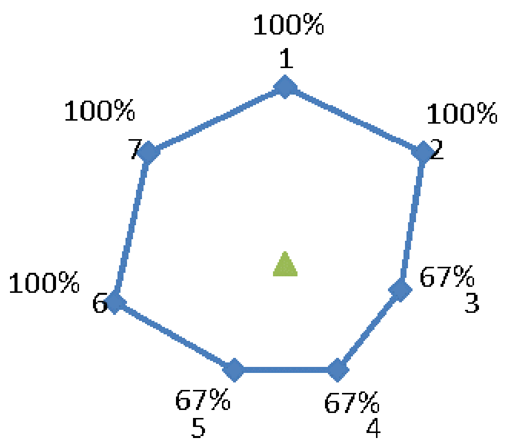

Figure 2.1 – Game evaluation results.

2.5 Conclusion

All of the games carried out the integration of the items, the connection with the business reality and the intrinsic (in-game) theoretical embarkation. The absolute majority was able to stimulate decision making by the players and presented innovative design in some of the items of the game. The absolute minority of the games did not present total clarity in the rules of the games, as well as the novelty of the theme and/or rarity. The results demonstrate that the methodology used with games managed to offer a pedagogical action with high efficiency in student learning, being an alternative in the Engineering courses.

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CHAPTER 3

Formula SAE Project: A Practical Approach to The Theoretical Concepts of Engineering

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Abstract: The Formula SAE project was born in 1981 in the USA due to the lack of Engineers specialised in high performance vehicles and spread out over the world. The Formula SAE Unesp Racing Team has been in activity since 2009 and nowadays gathers around 35 active members. This project provides Engineering students a hands-on opportunity to apply in practice the theoretical concepts they learn in classroom. It challenges students from several Engineering courses to seek knowledge beyond their undergraduate courses and join multidisciplinary teams that must completely design and build together an open-wheeled single-seater formula race car. This article investigated the impact of Formula SAE project on the academic life of UNESP Guaratinguetá Campus and how the project allows strengthening the student's link to the Engineering course and profession. The methodology was based on exploratory research with data collection by questionnaire among the members of the Unesp Racing team, from Faculdade de Engenharia de Guaratinguetá, UNESP, in the period of 2017-2018. The survey revealed that 80% of the interviewed students declared that the project developed by the student team fully contributes to integrate into practice the multiple theoretical contents of the Engineering courses. Also, 100% of the students completely agreed that Formula SAE requires students to deepen into theoretical knowledge and simulation softwares. The same amount of the population considered that teamwork is critical to the project development. This is confirmed by observing that the team is divided into hierarchically organized sectors, each one responsible for a part of the design and creation of the vehicle, that meet bi-weekly to check the progress of the project and to set deadlines for achieving the planned goals. It is worthy noting that 100% of the surveyed partially agreed that the project has conceptual topics not covered by Engineering course subjects. As a result of this study, it is possible to note that the Formula SAE motivates students to deepen their theoretical knowledge and to develop soft skills on Engineering.These topics contribute to prepare a future top range Engineer, since proactivity, team-working and cutting edge skills are valuable to the motorsports career.

Keywords: Designing, Engineering Education, Formula SAE, Practical Learning, Team-working, Theory.

3.1 Background

Among the students of UNESP Guaratinguetá, there are several reports of their disappointment with the Engineering education due to the large amount of theoretical subjects, few practical learning and lack of knowledge of the applicability of these subjects in the professional career. The feeling of distancing between the theoretical concepts and practice experienced by the students sometimes implies their low performance and commitment to the course, resulting in some cases of discontinuance in pursuing the bachelor's degree. The purpose of this article is to show how Formula SAE contributed to its participants being more integrated and motivated with either the practical learning and Engineering education [1-4].

3.2 Hypothesis

The hypothesis of this article is that participation in educational extension activities such as Formula SAE helps students to integrate the theoretical concepts with the practical approach so that they feel more motivated with the course and capable to be qualified Engineers.

3.3 Method

To test the proposed hypothesis, the methodology used was based on exploratory descriptive-quantitative research with data collection by questionnaire among a group of members from Unesp Racing Formula SAE team, which is one of some educational extension activities available at UNESP Guaratinguetá campus site. The Unesp Racing team is divided into sectors that deal with different parts of the vehicle's design and work together to make the project effective. These sectors are responsible for administrative, powertrain, structures, vehicle dynamics, aerodynamics and electronics issues. Team members generally learn how to produce the components needed to build the car and reconcile their theoretical knowledge to manufacture it. The final result of the project is the prototype in Figure 3.1.

3.4 Results

The group of surveyed members has 5 participants, each from a different section of the team and they were submitted to the following seven statements: (1) The Formula SAE project makes it possible to integrate the various Engineering's conceptual parts; (2) The Formula SAE project offers the opportunity to students to seek more theoretical knowledge; (3) The Formula SAE project strengthens the bonds with the Engineering course; (4) The Formula

Figure 3.1 – Unesp Racing's 2017 prototype.

SAE project works as a tool of student's search for innovation; (5) The Formula SAE project strengthens teamwork; (6) The Formula SAE project experiences conceptual topics not offered in the course subjects; and (7) The Formula SAE project allows students to discover the novelty in their academic itinerary.

Figure 3.2 shows the percentage of agreement to each proposed statements.

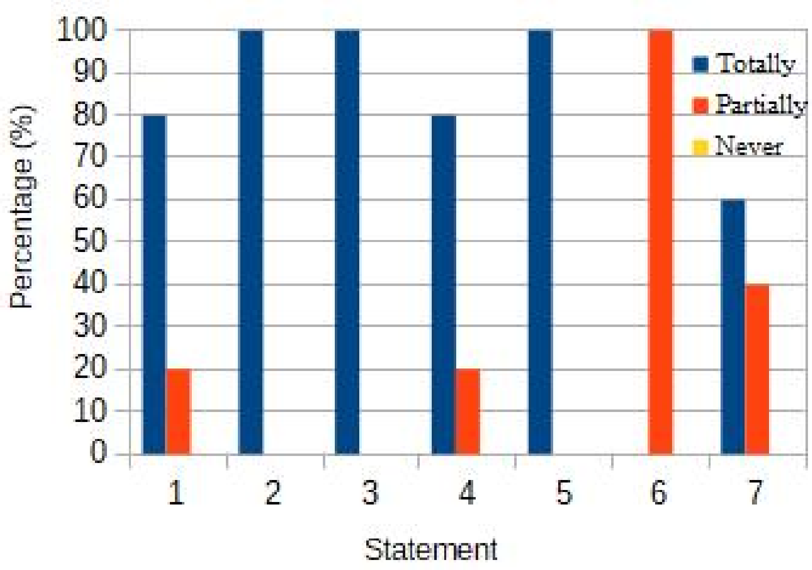

Figure 3.2 – Percentages of agreement to each statement.

3.5 Conclusion

Summarising, the aim of this article was to show the impact of Formula SAE in academic life and how students feel more motivated and capable after participating in an educational extension activity that conciliates both theoretical concepts and practical approaches. The practice was fundamental to improve the absorption of the subjects offered in the Engineering courses, as well as in the development of the skills of teamwork. According to the members of Unesp Racing, the project strengthens the bonds with Engineering and offers the opportunity to the student to not only deepen their studies up on offered subjects at the course but as well to go further to seek more theoretical knowledge. However, it is possible to state that the extension does not provide conceptual topics beyond from those already taught at UNESP. To conclude, Formula SAE is a project that effectively enhances skills and motivates Engineering students.

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CHAPTER 4

Analysis of the Formation in Engineering by The Experience Lived in The Science without Borders: Approach of Pedagogical Differences between Japan and Brazil

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Abstract: The introduction of the Science without Borders (CsF) program in Brazil has stimulated many University students, especially from the exact sciences, biological and health, in search of new experiences in countries that are referenced in their respective fields. The students' desired to experience a different culture and to have in-depth contact with a foreign language these were of the reasons that led to the international academic exchanges to several countries. Japan was one of the countries that opened its doors for Brazilian students from 2013, after overcoming the catastrophe by the Tsunami which hit on of March 11, 2011. Public higher education in Japan is characterized by the value of research and teamwork, being that all students from the third year are required to belong to a laboratory to carry out internships, and if they are interested, they may apply for a vacancy in the laboratory in the last year of their course. The practical and laboratory participation corresponds to 40% of the academic curriculum in Japan, whereas in Brazil the emphasis is on theoretical classes. Brazilian students are more prepared in theoretical concepts than the Japanese students because of the greater amount of information absorbed during the Engineering course. The methodology used in this work was exploratory and the data collection by observation. The research is a case study from the years 2015 to 2016 by a student at Tohoku University in Sendai, Japan and from 2010 to 2015 and 2016 to 2017 at the Federal University of Goias, in Goiania, Brazil, with the objective of presenting the differences in the academic structure and its influences in the formation of the Engineering professionals between Japan and Brazil.

Keywords: Education, Engineering, Brazil, Japan, Exchange.

4.1 Introduction

The creation of Sciences without Frontiers (CsF) in 2011 was undoubtedly one of the largest investments that the Brazilian government has ever made in the history of education. In total, R$ 8.4 billion were invested, and more than 100 thousand scholarships were awarded for undergraduate and graduate studies in Universities of 54 countries. During this period there was greater contact, mainly of undergraduate students, with research and innovations[1-2]. Several highlights and awards were received by Brazilian researchers[3]. The Japanese Government in the Meiji Era known as the Enlightened Government[4] was a time of modernization and openness of international relations with other economic and military powers of the time. One of the tactics of the Japanese government was the massive investment in education, and many Japanese students were sent to Europe in several areas of scientific knowledge. The result was the great scientific, industrial, cultural, educational and economic development that had its roots implanted 150 years ago[4].

4.2 Hypothesis

In this way, Japan is a model country that has made an investment policy similar to Brazil in the past and that has resulted in the advent of superpower in a short period of time. It is an opportune moment - due to these similarities of investment in education - to make a comparison of the educational methodology between the two countries[4].

4.3 Methodology

The research is a case study of the graduation in Engineering from 2010 to 2017 at the Federal University of Goias in Brazil and a part of it made by the CsF during the years between 2015 and 2016 at the Tohoku University, Japan. The comparison was made through the approach of the contents of the subjects taught as well as their respective schedules. In this article it is considered a class equivalent to two hours of workload (credits). It is also worth mentioning the resources that are used in both countries when teaching a class, amount of tests, extracurricular tasks and the behavior of students and their participation in attending a lesson. Besides the academic questions, the differences were also considered regarding the participation of undergraduate students in the research and their stay in some laboratory.

4.4 Results

In order to visualize the differences more clearly, a table was created analyzing the similar disciplines given in one semester according to the presented syllabus in the year of 2015 and 2016. Table 4.1 is a comparison between quantities of classes and their respective workload hours. It is curious to note that the disciplines in Japan are taught once a week during the semester, while in Brazil it is given twice a week. The content of the theoretical discussions in Brazil are more in depth and dense, in contrast in Japan they are introductory and not detailed. Another observation that was considered is the duration of the bachelor's degree in Engineering. Table 4.2 shows the average duration of an Engineering course in Brazil and Japan[5-6]. Such a difference is intrinsically related to the quality of secondary education in both countries. It is common for Brazilian students to study calculus in the first year of college, but this does not happen in Japan. Exact students have been studying high school since high school, so about a year of baccalaureate can be reduced and only disciplines of revision are enough for the progress of the course.

From the point of view of the way in which lectures are administered, the professors of both countries resemble some points and differ in the others. It is interesting that the form of interaction of the professor and the student is deeply related to the culture and the good manners determined by each society under analysis. In Brazil, there is a predominance of lectures with the use of slates and projectors to teach classes. The use of the PBL methodology [6] has occurred. In Japan, however, the slate is not widely used and its ministrations focus on the use of projectors. Practically more than 90% of lectures used only projectors, and in the lived experience there was no professors who used the

PBL style in their ministrations.

Table 4.1 – Differences of Workloads.

Subjects	Lectures	Workloads per Lectures (h)	Total Workloads (h)
Brasil			
Power Electronics	30	2	60
Japan			
Introduction of Power Electronics	16	2	32

Due to few face-to-face classes at Japanese Universities, the assessment is also done differently. In general, the professor evaluates the student using three fundamental criteria: presence, participation (homework and lists) and final evaluation in writing. Each criterion corresponds to a third of the total grade of the students, varying from professor to professor, and the final evaluation is done only once at the end of the semester. In Brazilian Universities, the usual is to evaluate the student only with tests, and during the semester is applied about three tests. In some cases, lists, assignments, and presentations are a supplement to help with student assessments.

Table 4.2 – Average Duration of Engineering Courses.

	Years		Years
Brasil	5	Japan	4

It is interesting to analyze the interaction of the teacher and the students, as well as their respective participation in the lecture room. It is very common in Brazilian Universities the students interacting in the lecture room with the professor and vice versa. It is common to raise questions during class, and therefore, students are free to ask questions throughout the lecture. One does not have in the pupil a concern to interrupt the class due to a questioning. In addition, the debate and discussion is much more present and more sought after by professors. In Japan the lectures are similar to a speech, in which basically only the professor has a voice. Even with a more liberal attitude of the professor to the students in the classroom, and in an attempt to force them to interact boldly, such actions are frustrated by their passivity. The students do not talk to each other, nor even interact with the professor, so even if there are questions about the content, they do not have the audacity or the freedom to question them. Presentations and discussions by students are rare, practically nonexistent. The conventional and conservative method is still strongly intertwined in Japanese Universities.

In Brazil the common sense in Engineering degree is not focused on the research, although there are programs such as PIBIC, PIBIT and among others [7], it is not an obligation of students to do so. Even in the final paper work, there is no concern of the student to dedicate himself to research or belong to a specific area, although there are competent students and professors, thirsting to achieve advances in science, many times are prevented due to the structure precariousness of laboratories and the lack of resources that Universities offer. In Japan - especially the public ones - they are endowed with the resources, investments and appropriate structures to carry out cutting-edge research. From the third year of graduation, the students make technical visits of the laboratories that interest them so that they can belong until the last year of graduation. It is indispensable to the student to belong to some research laboratory, because the internships in it are compulsory credits to receive the bachelor's degree. In any case, undergraduates go on the research side, and are encouraged to specify in a given research area.

4.5 Conclusion

From experience, one notices that Brazil is not far behind Japan in terms of theoretical content. In fact, the Brazilian students are much better prepared in theories than the Japanese, due to the high hours of content that are studied throughout the course. The interesting is the coverage of subjects that are taken from Brazilian Universities, and therefore the students' vast vision of solving problems that many times a Japanese student would have difficulty. Unfortunately, about researches, Japanese students are well prepared, and because of the discipline and dedication taught early on, they achieve great success and good results in their work.

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CHAPTER 5

Application of Problem Based Learning (PBL) to The Discipline of The Civil Engineering Course

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Abstract: This study aims to present the planning for the application of the method in undergraduate education in Civil Engineering by the Management Notions discipline for Engineering in the city of Maraba. The study was structured to be conducted in ways that are considered the perceptions of students and teachers on the use of BPA as a teaching and learning tool. Therefore, it is intended to apply the method according to the proposed in the literature. The objective of this paper is to present the planning of the implementation of the ABP. a visit to a higher education institution that uses the current method of graduation in order to observe in practice the development of ABP was held. For plans of problems cycles it uses the Canvas adapted to education as proposed by Marques (2017). The method used was qualitative in nature, which is expected to analyze the perceptions of students and teachers on the implementation of PBL. It is intended by this research contribute to the formation of the Engineer, reducing the gap between theory and practice.

Keywords: ABP Education, Engineering, Civil Engineering, Education, Vocational Training.

5.1 Background

Education has long been perceived as a strategic area for the development of a nation. History shows that countries that have dedicated themselves to promoting quality education in all its segments, achieved after some time has a different level of economic stability compared to other nations who have not had the same initiative [1-6].

In this challenge, it is clear that with regard to courses of general Engineering, within the list of activities designed to Engineers listed in Resolution 218/73 CONFEA, which indicates the possibility of its activities in the education and training of new Engineers presents itself as one that raises a number of discussions. Nitsch et al. (2004), points out that the Engineer who becomes a teacher finds a new environment for which it was not formed and where much it is required [4].

Parallel to this, there is criticism of traditional education that have been raised today, these criticisms relate to the passive learner action that is often treated as a mere listener of the information that the teacher explains. Cury (2008) describes this model where the teacher is the center of knowledge, expert and transmitter, the student ideal fractions (program content) in order to provide maximum utilization of all resources involved, including the time and space [1].

In this sense, it is worth considering the presentation skills and teaching methods to teachers of the course, to thus enable these professionals greater interaction in the relationship between teachers and students, and thus enable a more favorable environment for a better process building knowledge to these students, even if the teachers do not have the field of educational disciplines mentioned above.

In this sense, methods such as BPA (Based Learning Problems) are presented as an interesting possibility so that you can minimize the impact evidenced by how establishes the teaching and learning relationship within the Civil Engineering course in accordance with the proposed curriculum frameworks for most courses held in Brazil.

5.2 Purpose/Hypothesis

This study aims to present the planning for the use of PBL for the course in Civil Engineering through its application in Administration notions Engineering discipline to a public University in the city of Maraba.

5.3 Design/Method

For this survey are set a few steps. Initially, we consulted the literature on what is produced on the Problem-Based Learning. To support relative to the literature review, there was a technical visit in higher education institution applying the curriculum of the medical course of BPA.

With regard to the proposed implementation was selected discipline and define the activities to be performed within each issue cycle taking into account the literature records and technical visit. As a tool for planning the problems to be used during the course used the Canvas. See Figure 5.1, the Canvas facing education used by Marques and Navarro (2017) [2].

Figure 5.1 – Canvas facing education.

Subsequently, the evaluation of the use of the method, taking into account the perceptions of teachers and students involved in the research. For this evaluation will be the performance evaluation forms used.

5.4 Results

The research is expected to take place between April and December 2018, being applied in two different classes in this period. At this time, after the initial cycles achieved, research has shown promising results.

Students initially described the teacher as subjects who may have trouble adapting the methodology presented a different behavior than expected, and in this sense has shown good performance during the cycles of the problems. It is observed that good use of the studies by these students as the proposals for solving problems show a satisfactory level of dedication to the study.

Although research to be only in its early stages, the surprising result of the students in the early cycles has urged the teacher to extend this approach to other disciplines, whose income presented by the students is historically lower than expected. In fact, for the teacher this methodology should help to form effective to improve the teaching and learning process for the subjects which are being applied methodology.

5.5 Conclusions

The ABP method was designed to meet an increasingly intense requirement in order to train professionals who, during their training, also develop the skills and competences that meet the requirements of this market, helping to bridge the gap between theory and practice. However, difficulties, especially with regard to a change of behavior, in which the teacher is the holder of the knowledge and it is up to this to transfer the information to the students However, the literature shows despite increasing your study time and workload, most students positively evaluate the methodology for providing dynamic and motivating lessons and promote interpersonal skills, research and troubleshooting.

The development of attitudes such as respect for the views of colleagues, adaptability, autonomy, collaboration represents a significant gain, either by students or by the teacher.

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CHAPTER 6

A Qualitative Evaluation of Student Perceptions of the PBL Process

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Abstract: The education process challenged us to translate constructivism into new practices as research in science education focuses on evaluating the student perceptions of the PBL process, in instance, as working in groups and its assessment for effective construction of knowledge and development of competencies. This work aims to survey the social representation of Engineering students on the PBL active methodology application on technical subjects' classes. Five subjects from Computing, Electrical and Mechanical Engineering courses of two major Universities within Brazil centre were considered. 115 students evaluated the methodology. A percentage of 69,7% of the total universe answered the questionnaire, leading to a margin of error of 3% and confidence of 90%, with $p = 85\%$ estimated from the standard deviation of the calculated mean percentage of 31%. A Likert Scale were utilized in order to evaluate 10 items of 4 dimensions: team work, multidisciplinary aspect, learnability and leadership. Results show that all 10 items of four dimensions have great correlation from class to class, independent of university, course and grade. In general, students supported the assessment and suggested that some items could be merged. Overall, behavioral skills were perceived as motivators of group process, as cognitive skills were perceived as necessary for group

discussion success.

Keywords: Problem based learning, Higher Education, Alive Engineering, Construction of Knowledge, Competencies.

6.1 Background

Problem-based Learning process is a well accepted as a strategy for structuring leaning in higher education as far as new knowledge created from individuals through live experience as well as lab experiments [1]. The education process challenged us to translate constructivism into new practices as research in science education focuses on evaluating the student perceptions of the PBL process, in instance, as working in groups and its assessment for effective construction of knowledge and development of competencies. Most of the PBLs problems sustains that constructivism is a learning theory and not an instructional-design one. In this way it develops a more experiential and meaningful learning environment [2].

6.2 Purpose/Hypothesis

This work aims to survey the social representation of Engineering students on the PBL active methodology application on technical subjects' classes. Is considers their perception over Kolb's Experiential Learning issues, especially those related to team work and leadership [3].

This study aims to evaluate how Kolb's Experiential Learning could give undergraduate Engineering students a more practical experience on leadership and soft skills. Thence, we arise the following questions [4]:

(i) Are there different social representation of Engineering students on the PBL active methodology application on technical subjects' classes;

(ii) Are there clusters of social representation of Engineering students on the PBL active methodology application on technical subjects' classes?

(iii) Are the any correlation on clusters and students grades?

6.3 Design/Method

Five subjects from Computing, Electrical and Mechanical Engineering courses of these two major Universities within Brazil centre were considered: Escola de Engenharia Elétrica, Mecânica e de Computação at Universidade Federal de Goiás and Escola de Ciência Exatas e da Computação at Pontifícia Universidade Católica de Goiás.

A percentage of 69,7% of the total universe answered the questionnaire, leading to a margin of error of 3% and confidence of 90%, with p = 85% estimated from the standard deviation of the calculated mean percentage of 31%. A Likert Scale were utilized in order to evaluate 10 items of 4 dimensions:

(a) How much do you perceive the PBL method as “DYNAMIC”?

(b) How much does the PBL method stimulate you to “SEEK KNOWLEDGE”?

(c) Have you learned more by the PBL method in “WORKING INDIVIDUALLY" or ‘WORKING IN GROUP”?

(d) How much did the PBL method require you to “LEAD” your group?

(e) How did the PBL method lead you to seek “SELF-LEARNING”?

(f) How much did the PBL method expose you to “RELATIONSHIP PROBLEMS” in the group?

(g) Has the PBL method required you to experience “MULTIDISCIPLINARITY” to solve problems?

(h) What ROLE did you most develop during PBL executions (albeit informally): LEADER or PARTICIPANT?

(i) Do you consider that this learning method for application in your Course: ... should not be applied to any discipline ... should be applied to all course subjects?

(j) How much does the Method achieve educational objectives (compliance with all program content)?

To group students who show similar attributes we used the process of partitioning the answers data set into subsets by using the k-means clustering method. Its algorithm seeks for k groups iteratively by assigning each data point to one of the k groups [5]. The iterative process consists of

Step 1 - Initialising the k-partition $P = [a_1, ..., a_k]$ based on students' answers (a_i);

Step 2 - Assigning each object x_j in the data set to the nearest cluster $Cluster_i$ such as $x_j \in Cluster_i$ if $||x_j – a_1|| < ||x_j – a_i||$, for $j = 1, \ldots, n$ and $j = 1, \ldots, k$;

Step 3 - Recalculating the cluster matrix based on the partition

$$a_i = \frac{1}{N_i} . \sum_{x_j \in Cluster_i} x_j;$$

Step 4 - The iteration process continues until no cluster changes.

6.4 Results

From the k-means method, we defined two clusters:

(i) Cluster 1 with 40% of respondents and witch grades mean were 6,77, showed as the first dominant aspect "WORKING INDIVIDUALLY", and as the second dominant aspect "less stimulated to SEEK KNOWLEDGE".

(ii) Cluster 2 with 60% of respondents and witch grades mean were 8,97, showed as the first dominant aspect "WORKING IN GROUP", and as the second dominant aspect "more stimulated to SEEK KNOWLEDGE".

Therefore, we obtained that the two main factors that define those two clusters are:

(a) Have you learned more by the PBL method in "WORKING INDIVIDUALLY" or "WORKING IN GROUP"?

(b) How much does the PBL method stimulate you to "SEEK KNOWLEDGE"?

6.5 Conclusion

Results show that all 10 items of four dimensions have great correlation from class to class, independent of university, course and grade. In general, students supported the assessment and suggested that some items could be merged. Overall, behavioral skills were perceived as motivators of group process, as cognitive skills were perceived as necessary for group discussion success. Thence, professor must induce students to Group Working by means of proposing stimulating problems in a way students must work together.

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CHAPTER 7

The Importance of The Implantation of Sustainability in The Engineering Graduation

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Abstract: This article demonstrates the relevance of, from college education, training Engineer swho not only have deep practical and theoretical knowledge, but also have social, environmental and economic concerns focused on sustainability with all of its plenitude. There search is developed from the literature review of the materials present on the subject, in order to confirm the theories developed during the body of the text. The relevance of this article comes from the need, acquired in the last decades, during the exercise of the Engineering profession, to contain the advance of the devastation of the environment. Because of their great participation in the changes that take place in the environment in which they work, the Engineer ends up having to adapt to the new world scenario, in which both society and the economic market request more sustainable model sofaction. Based on this fact, research was conducted that resulted in graphs and data related to new demand in the economic market for environmental certifications such as ISO 14001: 2015, applied in Brazil, which from 2016 to 2017 had an increase in the emission of about 544%.

However, on the other hand, it was verified through research carried out at the Polytechnic School of Pernambuco that only an average of 1,94% of the workload linked to Engineering training is intended for teaching sustainability, demonstrating the need for Universities to adapt their program for the current economic scenario. Besides the University program, it is necessary for the training of the Engineer to live the principles of sustainability, as in the concept of "living laboratory". The institutions of undergraduate education in Engineering appear as the factor that will enable and provide the means for this professional to reach the labor market with the necessary requirements in relation to the pillars of sustainability, covering the social, environmental and economic spheres.

Keywords: Engineering, Sustainability, Undergraduate Education, Dow Jones Sustainability Index, CSR - Corporate Social Responsibility.

7.1 Background

The preservation of the environment began to become an agenda in world proportions, starting at the end of the 20th century, with the realization of important conventions in which the main ones can be organized in a "line of evolution". These include the Stockholm Conference in 1972, the United Nations Conference on Environment and Development - Rio-92, which included the presentation of Agenda 21, one of the most important action to properly apply sustainable development, addressing an educational process of orientation and exposing, on a worldwide scale, the great relevance that education has in making society aware of its influence in the environment, and finally Rio +10 in 2002, which established the three pillars of sustainable development: economy, social and environment. The statement from this last mentioned meeting recommended to the United Nations General Assembly the "Decade of Education for Sustainable Development" (DESD), a learning process arising from the need for support to promote Sustainable Development [1]. Thus, it is necessary that this implantation in education also covers the Engineering degree in which education about concepts, techniques and advantages of the application of sustainability in the professional performance, brings results that go beyond environmental preservation, a significant differential for the performance and promotion of companies and the wellbeing of society.

7.2 Purpose/Hypothesis

The purpose of this paper is to analyze and explain the importance of the application of sustainability in undergraduate civil Engineering, after all, concern with environmental issues has become an increasingly preponderant habit in the development and formation of society. Consequently, the formation of this ecological consciousness, in different sectors and layers of the population, eventually encompassed the education sector and in particular, was reflected in higher education in one of the branches that most bring changes to the environment, Engineering course.

Given the importance of this relationship between education and sustainability, higher education has a priority role, since newly trained professionals will have to deal with social, environmental and economic resources. Thus, it will become remarkable that their functions in the pursuit of social transformations provide improvements in well-being for people of the present generation as well as future lineages.

Based on these principles, it should be noted that the Engineer of the future, in addition to needing to know the technology deeply and to understand contents, methods, theories or other aspects of technological knowledge, also needs an educational process focused on sustainability. The processes that can save energy and resources, reduce pollution, increase productivity with equitable distribution of income and avoid wasted capital, go through education and technological innovation, guided by environmental conservation [2]. Therefore, the formation of an Engineer, today, besides providing the technical knowledge of the profession, must offer a humanized education, dealing with socio-environmental issues as essential for the curriculum of these future professionals.

In the area of Engineering, corporations are among those that most benefit from using this new sustainable knowledge, since, following the imposed norms, besides bringing benefits to the environment reducing the impact generated, a business differential is obtained when being acquired and environmental seals. In an increasingly competitive world, companies gain comparative advantages in acquiring certifications that attest to their good business practice. The pressure for socially correct products and services causes companies to adopt internal reformulation processes to comply with the standards imposed by certification bodies [3].

Based on these facts, the emission rates of the ISO 14000 certifications of the years of 2015 were analyzed, whose growth demonstrates how relevant it is becoming to the market. In addition, we also calculated the percentage indices of sustainability-related courses present at the Polytechnic University of Pernambuco program [4], where the very low result exposes the deficiency that Universities still present on the subject. It is therefore noticeable that Universities have not yet adapted 100% to cover the need to train sustainable Engineers.

7.3 Design/Method

The present article was developed in order to explore and deepen knowledge about the subject matter through the bibliographic revision method, besides consulting the program of the Polytechnic School of Pernambuco in order to gather information about the courses offered in the various Engineering graduations ofered on campus. The surveys were conducted between December 2017 and April 2018 and generated graphs and information that will be exposed in the results of this article.

Bibliographical research is based on the collection of theoretical references already analyzed, and published by written and electronic means, such as books, scientific articles, website pages. Any scientific work begins with a bibliographical research, which allows the researcher to know what has already been studied on the subject. However, there are scientific researches that are based solely on bibliographic research, looking for theoretical references published with the objective of collecting information or previous knowledge about the problem on which the answer is sought [5].

7.4 Results

Through the website of the Polytechnic School of Pernambuco, in January 2018, the programs of the graduations of 7 (seven) Engineering offered by the institution were analyzed, being Civil, Computing, Electrical Electronic, Electrical Electrical, Electrical Telecommunications, Mechanics and Control and Automation. Based on this research, it was observed that in the electrical Engineering program only three courses were directly addressed to environmental themes, while in Civil Engineering, Electrical and Mechanical Engineering, two courses were found. With the smallest number of compulsory courses related to this sustainable subject, we find Computer Engineering, Electrical Telecommunications and Control and Automation, where it was analyzed that only one curricular component enters the totalworkload required.

Doing a periodic analysis, the graphic shown in Figure 7.1, is possible to identify the data sources of the curricular components in the total time load of the obligatory courses. In this case, the graduation in Electrotechnical Engineering presents a greater percentage value of 4.02% and the Control Engineering only 0.81%. As the disciplines can contemplate the areas of environmental study and diluted in facilities, it is noted that there is still a great lack of emphasis and curricular strategies that sustainability has in Engineering graduation.

Another analysis was carried out in relation to the issuance of ISO 14001: 2004 ABNT certificates and ISO 14001: 2015, where, through data collection on the INMETRO website in May 2018, a graphic was assembled (see the Figure 7.2), where can be noted the high growth of requests and emissions that the ISO 14001 certificates are receiving from 2008 to 2017. In 2015, there was the highest registered emission of ISO 14001: 2004 with 665 certificates. After this year, it becomes clear that 14001: 2015 has begun to become a more up-to-date and long-awaited certificate than 2004.

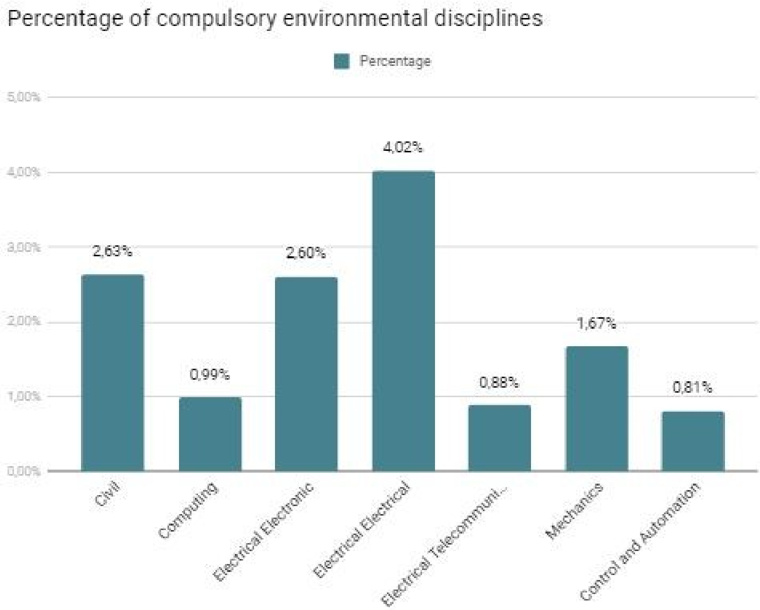

Figure 7.1 – Percentage of compulsory environmental disciplines.

In 2018 alone, this search [6] for the ISO 14001: 2015 certificate achieved a great growth (see the Figure 7.3), where it is expected to surpass its total recorded for the year 2017.

Figure 7.2 – ABNT NBR ISO 14001:2004 and ABNT NBR ISO 14001:2015.

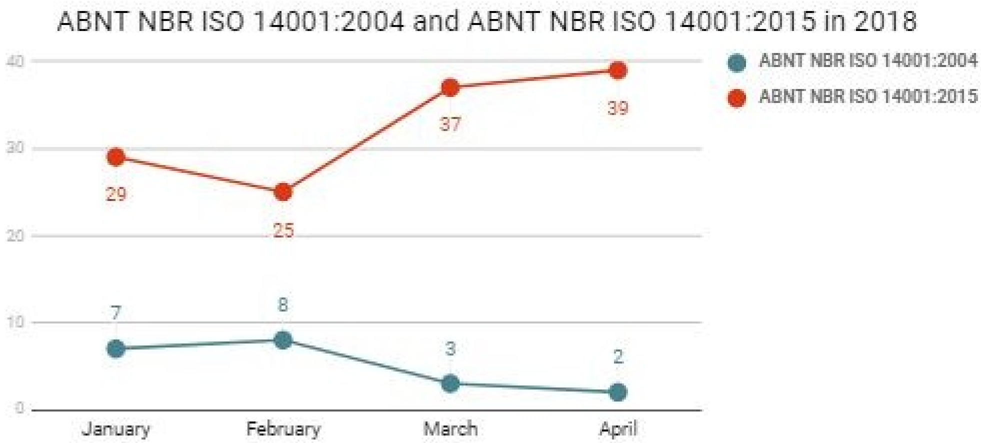

Figure 7.3 – ABNT NBR ISO 14001:2004 and ABNT NBR ISO 14001:2015 in 2018.

7.5 Conclusions

In the progress of this article it was observed that the role of the Engineer in society is indispensable, but that the profession can bring both benefits and harm to the environment in which it operates. Sustainability emerges as a necessary factor for the maintenance of modern Engineers, as organizations have become aware that economic growth, without a concern for the replacement of natural resources, has not been favorable to either party.

Therefore, it can be concluded from the analysis made in the program of the Engineering courses of the Polytechnic School of Pernambuco and in the issuance of ISO 14000 certificates by companies, that the graduation should suit, increasing the offerings of courses related to sustainability , the growing demand of society for sustainable actions in the Engineering field, resulting in the exercise of the profession focused on environmental, social and economic concerns.

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CHAPTER 8

Qualitative and Numerical Analysis of Didactic Model in The Structural Mechanics Teaching

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Abstract: Based on data from MEC (Ministry of Education), the CNI (Industry National Confederation)5 came to the conclusion that the dropout rate of En-

gineering students from Brazil's Universities is more than 50% and that this can be associated with the low knowledge level of mathematics and science besides mismatch between the traditional teaching and the different learning styles of students. As mentioned by Felder and Silverman (1988), there are a lot of people with several different learning styles, e. g, by seeing and hearing or reflecting and acting. Therefore, the use of this traditional teaching method can be unsatisfactory for a specific group of students. Most of the teaching method is supported by verbal information (lecturing) and visual representation (sentences, formulas and symbols written in handouts or on blackboard). Thus, Engineering teachers should seek out for alternatives ways of teaching that could make the learning environment more enriching. What would that be? The use of suitable methodologies for the evaluation of theoretical and computational models shown in a classroom is essential for teach Engineering students and improve their quality and efficiency. Specifically, in the structural mechanics teaching, tools for developing a better understanding of the behavior of structures, like the adoption of the structural didactic models, play an important role. These models are physical models that try to simulate the real behavior of architectural structures, allowing the students to realize how different structural elements work. They consist of a set of modular pieces which are connected to each other by their joints, which can be made with low-cost materials. The main goal of this work is to show the incorporation of a set of didactic models, designed by civil Engineering students enrolled in the Structural Analysis and Strength of Materials course at the UESC (Universidade Estadual de Santa Cruz), located at Ilhéus, Brazil, in the analysis of columns buckling and deflection of beams and frames with distinct boundary conditions and loads. For buckling effect, the column was simulated by an aluminum piece supported by a wood structure where its deformed shape was compared with that one found in the literature. The deformed shape result of didactic model was compatible with the literature. For beams and frames didactic models, their deflections were measured in several points by a mechanical extensometer and the obtained results were compared with the analytical formulation (Castigliano's First Theorem) and numerical model that use the FTOOL program. Some concrete blocks were used to simulate a distributed load with their weights and dimensions measured appropriately. The results obtained for simply supported beam are similar to those obtained with FTOOL and Castigliano's Theorem (8% error percentage). For the cantilever beam the deflection obtained had a considerable discrepancy compared to numerical and analytical results. Three different Frames models had results approximately close to numerical and analytical analysis. It can be concluded that the use of the didactic model is an important tool to improve the learning level of students, by helping them to reach a better understanding of the structural behavior.

Keywords: Didactic Model, Engineering Education, FTOOL, Structural Mechanics, UESC.

8.1 Background

At Brazilian Universities the Engineering student dropout rate is considerably high as showed by studies performed by CNI (Industry National Confederation). There are a lot of reasons for that, among them are the low knowledge of mathematics and science and the distinct styles between teaching and learning. With this in mind, it is important to find out methods that can contribute to reduction of this rate. Application of didactic model in civil Engineering teaching is a powerful tool in the learning process in the courses of structural mechanics and has been used by many researchers. Oliveira (2008)[1] developed the Mola Model to evaluate the behaviour of steel structures while Santos (2011)[2] and Rocha et al (2016) [3] designed an EPS (Expanded Polystyrene) beam didactic model to show experimentally what happens when different loads are applied doing the students realized the connection between the practical procedures and theoretical perspectives. Maia et al (2017)[4] emphasized the importance of the didactic model as a method to enrich the knowledge of the students. For all that was said above, some kinds of didactic model were designed to analyse column buckling, beams and frames deflections as a support to structural analysis teaching. No expensive investment was required because it was used materials easily found as wood and metals.

8.2 Purpose/Hypothesis

In order to improve practices of learning and teaching activities, in the first semester of 2017, in the discipline strength of materials, students were divided into groups with up to 5 students, where each one of them were encouraged to develop a specific didactic models to simulate a structural behaviour. For each model several requirements were established. In this present work the analysis is focused just in the study of column buckling.

8.3 Design/Method

In the buckling column simulator design, its manufacturing process required the use of some materials such as wood, angles and sheet metal, as shown in Figures 8.1 and 8.3.

The dimensions of each one of the elements are summarized in the Table 8.1.

The main idea of this buckling simulator is to demonstrate a qualitative analysis of the deformed shape of the sheet metal for different boundary con-

Table 8.1 – Dimensions of the buckling simulator components.

Element	Length (cm)	Width (cm)	Thickness (cm)
Piece 1	5,4	4,2	3,2
Piece 2	11,0	5,8	2,3
Piece 3	16,0	——	——
Piece 4	16,7	5,6	2,8
Piece 5	8,2	5,3	3

ditions and compare it with the results found in the literature. Basically, this analysis consists of applying an axial compression effort on the top of the metal sheet and verifying its deformed configuration.

8.4 Results

The Figures 8.4 and 8.6 show the deformed shape for three boundary conditions: clamped-free, simply supported and clamped-clamped.

As expected, see Figures 8.4 and 8.6, the buckling simulator presented good results for all three boundary conditions support when compared with that one found in the literature.

8.5 Conclusions

Through this work, it has been demonstrated how the use of didactic model can be a powerful tool in the mechanical structural teaching giving to students a better support to understand the behavior of the structures that they learn in classroom. So, it is important to realize these didactic models as a good strategic material that should be incorporated into Engineering education.

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Figure 8.1 – (a)

Figure 8.2 – (b)

Figure 8.3 – (c)

Schematic of the project: (a) buckling simulator; (b) angles; and (c) sheet metal.

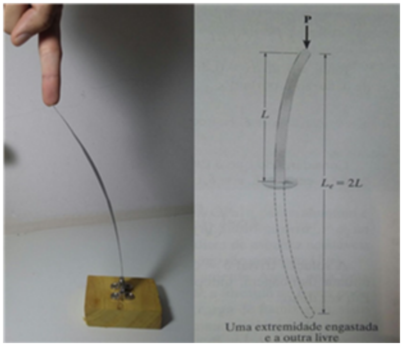

Figure 8.4 – (a)

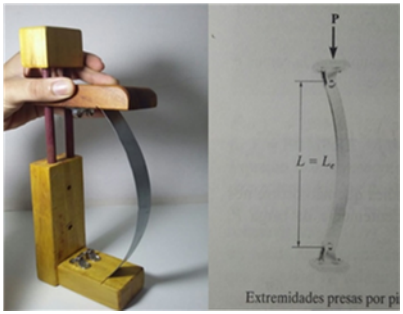

Figure 8.5 – (b)

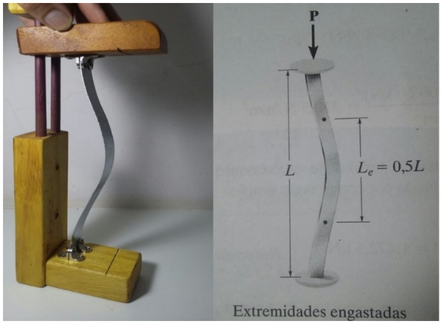

Figure 8.6 – (c)

Sheet metal deformed configuration for three boundary conditions: (a) clamped-free; (b) simply supported; and (c) clamped-clamped.

CHAPTER 9

Online Platform for Learning of Electrical Power Systems

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Abstract: The learning of Electric Power Systems (EPS) is related to the experience of the students with the technologies used in this area. To allow a better understanding of this subject is important to have practical classes. However, because of the cost, size and/or access to EPS, it is difficulty to provide this field experience to students. This understanding can be obtained through the use of computational simulators. Tools that allow the make of several operating conditions of a real system. When these platforms are open access they do not have user-friendly interface and freedom of assembly. While private plat-

forms have a high acquisition cost and focus on application and not teaching. In this scenario an online didactic tool was developed to allow the adequate simulation of systems. For this, the tool has online access, teaching-oriented interface and uses Optimization to find the power flow. The Optimization method demonstrates effectiveness for this use, due to the speed of resolution and the adaptation to the model. In it the objective function of minimization is given by the active power flow in the load and generation bus, while the constraints are the reactive power flux in the load bus and the active and reactive power injected by the generation and reference bus, besides the voltage limit of each bus and accuracy. While the variables are the voltage and angle of each bus, which at the end of the process will be used to calculate the power flow and then the short circuit current. The algorithm is being developed in the mathematical modeling tool AMPL, in the version for student, and uses the free solver IPOPT; the virtual interface is implemented in the Heroku platform, in Python language, with the Flask library and the database by MongoDB. The try-out of the values obtained by the platform occurs by the simulation of examples with solution present in textbooks. Such examples will have them meshes available in the tool to aid the learning in the subjects related to electrical power systems. The use of optimization to calculate power flow is effective for accuracy and speed, as compared between systems present in textbook and platform-mounted examples. The virtual access occurs by the address https://pesep-app.herokuapp.com/#. Which does not require computational infrastructure requirements and where the evolution of the tool can be monitored.

Keywords: AMPL, Educational program, Electrical Power Systems, Optimization, Power flow.

9.1 Background

Electric Power Systems is a branch of electrical Engineering responsible for power generation, transmission and distribution. This area of knowledge is largely present in the undergraduate and post-graduate courses in electrical Engineering[1].

To enable a better understanding of this vast subject, it is of great importance that practical lessons occur during the course of learning. However, due to the cost, size and/or access to EPS, there is great difficulty in providing this field experience to students[2]. In addition, the study of the overall behavior of a power system, considering the interaction between its various components, may not be satisfactorily demonstrated in the laboratory. This practice can be obtained through the use of computational simulators, tools that allow to explore several operating conditions of an actual system, as well as model hypothetical systems at the frontier of knowledge[3].

The use of simulation for assembly of electrical systems is a current concept in the literature, considering the simulators that allow operational practice, obtaining behaviors in graphs and solution of specific problems of the area[4]. A relevant number of these business tools have academic licenses marketed at a lower cost to educational institutions. However, such tools may not be adequate to the objectives of the disciplines, since they present a more application bias[5]. In contrast, the free platforms, for the most part, have no user-friendly interface and freedom to mount the system. And the ones that have need another private software to run[6].

9.2 Purpose/Hypothesis

This work has the main objective in develop a didactic platform, with proper features of a EPS simulator[6], like examples available from pedagogical books, free and with online access, which allows the user to assemble systems composed of generation, load and reference bus, with the option of inserting capacitor banks, and lines, with transformer and associated impedance, obtain the power flow in the bus. It is not the objective of this work to demonstrate the development of the graphical interface of the platform, having specific work for it[7].

The following topics make up the objectives of this paper: (a) Modeling of the power flow using optimization and adapt them to the data available in the textbooks; (b) Elaboration of the graphical interface, platform deployment and communication of user data to the calculation core; (c) Validation of the calculation core from examples present in textbooks and interface by presentation to school groups.

9.3 Design/Method

A simulation platform of electrical power systems should allow the user to calculate the power flow mounted by the same8. To meet this demand, a computational structure was produced that performs these operations according to the theory shown in the following sections.

9.3.1 Power flow

Power Flow is a necessary calculation to obtain the active and reactive power transmitted between the bus of the system, classified as generation, load and reference, also known as PV, PQ and Slack. This last bus is mandatory for operation of the electrical system, to ensure the balance between the power injected and the power consumed in the network[9]. A two-bus system according to Figure 9.1 will be used as a reference for equation.

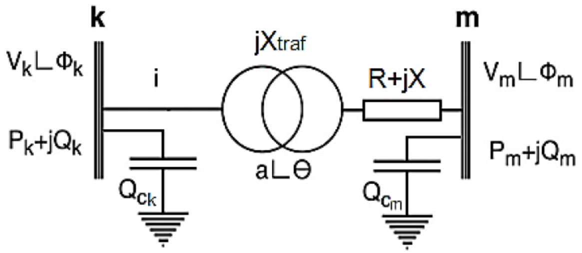

Figure 9.1 – Two-bus system reference.

The flow equation includes 2 subsystems, the first one dealing with generation and load bus, for active power, and only load, for reactive power. While the second in the active power and reactive.

$$P_k = V_k \sum_{m \epsilon k} V_m (G_{km} cos\Phi_{km} + B_{km} sen\Phi_{km}) \tag{1}$$

$$Q_k = Q_c + V_k \sum_{m \epsilon k} V_m (G_{km} sen\Phi_{km} + B_{km} cos\Phi_{km}) \tag{2}$$

$$P_k^{esp} - V_k \sum_{m \epsilon k} V_m (G_{km} cos\Phi_{km} + B_{km} sen\Phi_{km}) = 0 \tag{3}$$

$$Q_k^{esp} + Q_c - V_k \sum_{m \epsilon k} V_m (G_{km} sen\Phi_{km} + B_{km} cos\Phi_{km}) = 0 \tag{4}$$

At the end of the process, the voltages and angles of each bus will be obtained, which will be used to calculate the active and reactive powers of the generation bus.

And finally, the powers transmitted between the bus.

This equation is resolve, in current paper, using Optimization[10].

$$P_{ger_k} = P_{car_k} + \sum_{k,m} (V_k V_m (G_{k,m} \cos \Phi_{km} + B_{k,m} \operatorname{sen} \Phi_{km})) \quad (5)$$

$$Q_{ger_k} = Q_{car_k} + \sum_{k,m} (V_k V_m (G_{k,m} \operatorname{sen} \Phi_{km} + B_{k,m} \cos \Phi_{km})) \quad (6)$$

$$P_{km} = V_k^2 a_{km}^2 G_{km} - V_k V_m a_{km} (\mathrm{G_{km}} \cos(\Phi_{km} + \Theta_{km}) + B_{km} \operatorname{sen}(\Phi_{km} + \Theta_{km})) \quad (7)$$

$$Q_{km} = -V_k^2 a_{km}^2 B_{km} - V_k V_m a_{km} (\operatorname{sen}(\Phi_{km} + \Theta_{km}) - \cos(\Phi_{km} + \Theta_{km})) \quad (8)$$

$$P_{mk} = V_m^2 G_{mk} - V_m V_k a_{mk} (\cos(\Phi_{km} + \Theta_{km}) - \operatorname{sen}(\Phi_{km} + \Theta_{km})) \quad (9)$$

$$Q_{mk} = -V_m^2 B_{mk} + V_m V_k a_{mk} (\operatorname{sen}(\Phi_{km} + \Theta_{km}) + \cos(\Phi_{km} + \Theta_{km}) \quad (10)$$

9.3.2 The platform KVA

The platform Knowledge's Virtual Academy (KVA) is an online program developed at the Power Electronics and Electrical Drive Laboratory (LEPAC) of the Federal University of Espírito Santo (UFES), with an open source and focused on teaching EPS12. It can be accessed by the link www.kvaflow.com.

The program is divided in the API, where the calculation of the power flow occurs, as showed in the previous item, and the APP, where the input and output of data with the user occurs.

Assembling the system of Figure 9.2 in the interface, selecting the bus or the line it is possible to edit the modules of the electric quantities and by pressing the power flow button and then the report option is shown the output of the calculation.

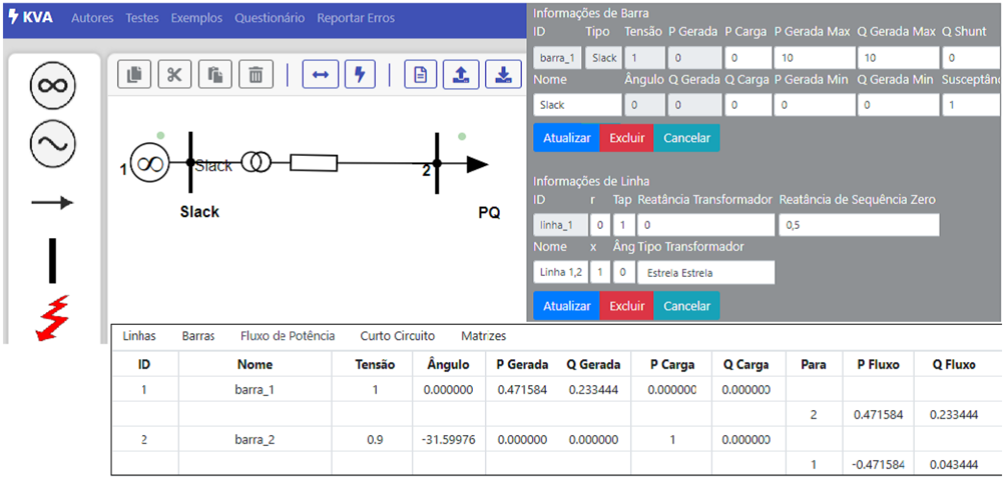

Figure 9.2 – Two-bus system in the plataform with modules of the bus K and output of the power flux.

9.4 Results

The option chosen to prove the assertiveness of the calculations carried out by the program was to simulate several examples taken from the textbooks about electrical Engineering. This choice was motivated by the fact that they present results for gauging and can serve as a tool for helping teachers and students.

One of the examples was taken from Luiz Cera Zanetta Jr.'s book Power Fundamentals of Power, 2006, this being number 6 of chapter 7. This example seeks to realize the power flow in a radial system of three buss, with a reference bus connected to two of load. Assembling this system of three bus on the platform, we obtain Figure 9.3.

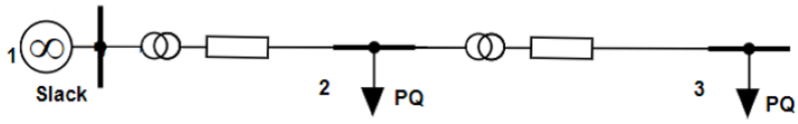

Figure 9.3 – Example of three bus system.

Table 9.1 – Comparison between reference book and KVA.

Electric magnitude	Bus	KVA	Reference book	Error
	1	0.9842	0.9842	0.0000%
Voltage	2	0.9566	0.9567	0.0105%
	3	1.0000	1.0000	-
	1	-3.0577	-3.0496	0.2656%
Angle	2	-5.1502	-5.1535	0.0640%
	3	0.0000	0.0000	-

The comparison of the program output with the book template, which shows the modules and angles of the bus voltages, is shown in Table 9.1.

9.5 Conclusions

The demand for educational programs for the SEP area arises as a matter of urgency, as this branch of knowledge tends to increase its complexity as new technologies are introduced into the market. This scenario aggravates the amount of information that the student must master in order to perform his function in the work environment, academic or otherwise. In this scenario, the KVA platform, in the academic environment, excluding the research area, meets the demand of the school body, given the assertiveness in the calculation of FP, and have examples that the user will develop during their learning. This bank covers the most used books, which will progressively receive more and more systems. The platform goes through daily updates and until the publication of this work the calculation of the short circuit in on the implementation phase, as well as the analysis of user feedback. It is expected that by the end of August the platform will be in its version for classroom use.

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CHAPTER 10

Academic Exchange and Outreach Projects: Training Students to Be Conscious of Their Role as Young Participants of Current Problems of Engineering and Society

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Abstract: In the present paper, the experience of a French exchange student of the EIVP (École des Ingénieurs de la Ville de Paris) at the UFRJ (Federal University of Rio de Janeiro) is described. The student was an intern at the UFRJ's MUDA Outreach Project, where she had the opportunity to visit two occupations supported by Brazilian social movements in previously unoccupied sites in the metropolitan area of Rio de Janeiro. We discuss whether the student's participation in such an experiment was able to provide positive results in terms of Engineering education. To this end, she participated in various projects taking place in the squat, which led to the elaboration of an internship report and later to an academic paper, in order to consolidate her learning. Based on reflections about the concept of "refugee", in Brazil and France, settlements initiatives and "homelessness" in both countries were analyzed and compared. The primary conclusion is that to be successful, settlements have to be carefully planned aiming at the inclusion of the individuals involved in societal institutions. In

addition, it is important to stimulate the learning of the concept of collective construction of housing, so as to assign meaning to space and their function as residents, both to alleviate possible tensions and to provide a means to consolidate their self- confidence and dignity, as individuals and citizens. In this sense, the University is no more the only holder of knowledge, but acts as a facilitator of the knowledge sharing process and at the same time training Brazilian and foreign students to be aware of their role as young participants of current issues in the interface between Engineering and society. Therefore, one can consider as quite successful the exchange student experience as an intern at the MUDA Outreach Project.

Keywords: Engineering Education, Academic Exchange, Interdisciplinary Studies, Social Inclusion, University Outreach.

10.1 Background

The program CAPES–BRAFITEC (BRAsil France Ingénieur TEChnologie) of academic cooperation between Brazil and France [1] has provided remarkable results in the training of Brazilian and French students, especially in recent years, when many of them pursued a double undergraduate degree.

In the last 10 years, the first author of the present paper has acted both as a coordinator of BRAFITEC and outreach projects at UFRJ (Federal University of Rio de Janeiro), notably the project MUDA2 (MUtirão De Agroecologia). This sort of activity proposes a kind of Engineering teaching where student interact with communities, breaching "academic walls" to practice technical solutions compatible with their reality. Much of these communities in underdeveloped countries are constituted by the poorer strata of society and lack many services that could be improved by contributions from many fields of study and research in Environmental and Civil Engineering, such as housing, sanitation, healthy food, food sovereignty, waste management and construction.

In this context, there arose in 2017 an opportunity to bring together the past experience of participation in outreach projects of an exchange student from the École d'Architecture of Paris Lavillette and EIVP (École des Ingénieurs de la Ville de Paris) — who is the second author of this paper — and the MUDA Outreach project, in which she was an intern for five months [2].

10.2 Purpose/Hypothesis

The purpose was to compare irregular occupations in Brazil and France, analyzing perceived differences and similarities. Political, cultural, social and economic expatriation of refugees in France and their struggle for housing is intertwined with the fight for survival in a country with little cultural or political affinity, including the basic difficulty with an unfamiliar language. According to the Abbé Pierre [3] foundation 4 million of people live in risky conditions today in France.

Such a situation has similarities with the political and economic exclusion of low-income Brazilians, who with few and precarious housing alternatives live in favelas, streets or squats. Two of the most important squats were organized by the National Movement for Housing Struggle (MNLM or Movimento Nacional de Luta pela Moradia, in Portuguese), which claims to act under a City Statute [4], which under certain conditions ensure the right of popular occupation of inhabited areas. They are: Manoel Congo, situated in a building at downtown of Rio de Janeiro and Solano Trindade [5], a 45.000 m^2 area located at Duque de Caxias, in the metropolitan region of Rio de Janeiro.

The central hypothesis of this paper is that the academic and cultural baggage of an exchange student, when contrasted with the reality of the conditions in Brazil, brought about by outreach projects can provide invaluable insights. The comparisons between the problematic of the occupations in Brazil and France made possible by outreach activities, can lead to an enrichment of the student's training both as an Engineer and a citizen, contributing to the formation of other students in Brazil and abroad.

10.3 Design/Method

The internship began with the student's training on MUDA activities at UFRJ campus. Thereafter, visits were made to the two occupations (Manuel Congo and Solano Trindade). They consisted in one- day and weekend stays, during which the student participated in workshops on bio-construction, healthy food produce and preparation, housing construction and agro-ecological gardening.

The Manuel Congo and Solano Trindade squats are examples of innovative ways to handle housing issues for low-income citizens. There are a total of 120 people living in Manuel Congo and the occupation project aims to build a restaurant, a samba house and a hairdresser shop.

The MNLM occupies the site of Solano Trindade since August 2014 [5]. The land was granted to the Movement by the federal government Secretariat of Patrimony for the specific purpose of realizing a housing project. The project includes an implementation of a transdisciplinary experimental campus through a technical cooperation between MNLM and UFRJ to complement the housing use. The activities are structured around "mutirões" (social joint efforts). In one of these "mutirões", a roof built by pieces of wood donated by UFRJ will house the communal kitchen of the community. Financial support was devised through a "crowd-funding", with phases of R$ 30,000 targets. The first target has been reached by November 2017. Solano Trindade, as the initial squat, currently has capacity to house ten families. The MNLM adopts a careful selection of new families, who undergo preparatory training to be part of the movement.

At the end of the internship, the student made a report and returned to Paris to do her final undergraduate project, where she addressed many of the topics she was able to go through regarding occupations of refugees and analyzing their similarities and differences in relation to occupations in Brazil.

10.4 Results

It can be seen from our research and experiment that if occupations are well inclusively planned, rather than reallocations to meet numerical targets, results can be quite significant, motivating profound and effective societal changes. Isolated initiatives, such as that of Great Synthe [6], evidence the fragility of solutions that are not built collectively, causing tensions and upheavals that lead to failure.

In present-day society, native or refugee citizens, know quite clearly the meaning of dignity. Partnerships among NGOs, social movements and Universities enrich dialogue, strengthen and perpetuate collective solutions. The intense cooperation built since the beginning of the Solano Trindade occupation and UFRJ demonstrates a strong willingness to redefine the role of the

University as the absolute holder of knowledge. Instead, the proposal is a multidisciplinary approach involving Social Technologies and outreach activities, thus providing an effective solution to current urgencies.

10.5 Conclusions

Solutions brought about by social movements in Brazil and associations in France show that the reuse of the city existing neglected spaces also highlights its rethinking through the concept of the social function of property. The hands on experience of the exchange student has shown that significant impacts in Engineering education and citizenship may follow from outreach projects.

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CHAPTER 11

Navigation System for The Visually Impaired: A Transformational Engineering Education Case

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Abstract: Society's problems are becoming more complex, broader and are multidisciplinary on their roots. In order to have market value Engineers must identify and solve societal problems whose solution benefit people, specially their quality of life. This work reports about an effort to address this issue by involving Engineering students on a human-centered project to promote the mobility of the visually impaired. The information about the environment and the precise guidance of visually impaired people is the basis for their safe mobility, especially in unknown spaces. Safe navigation of visually impaired people is based on cognitive maps, a mental spatial pattern of important locations or way-finding points. It involves storing the ordering or relationships between several variables that can be physical objects such as way-finding points or abstract objects such as ideas. Visually impaired and blind people need assistive technology systems to support effective navigation. One approach for assistive system placed within the physical environment is to embed a set of navigational beacons, using Bluetooth Low Energy (BLE) that can be activated to provide local cues for doorways, offices etc. behaving like a real time proximity-based locating system (BLE-RTLS). BLE beacons are small wireless devices that

transmit a nearly continuous radio signal, usually a few times every second. This signal tells the smart devices the beacon's ID number which is sent to a cloud server to find and retrieve the related information. This information triggers a customized event in the visually impaired app that is related to a specific location he/she is next to at that very moment, giving information about rooms, doors and stairs in front of the user, upcoming changes of the walking surface etc. The project deals with a successful hardware/software android system which enables communication of relevant location-aware information to a blind person carrying a Bluetooth enabled cell phone. It is focused on the case of navigating on an unknown indoor/outdoor environment of Centro Braille in Campinas (CCLBC). Information provided to the user, as he/she approaches the unit, includes a description of the institution, unit's topology and services available in three different floors. Care was taken to not overflow the user with information and to minimize the multiple beacons interference when the receiving signal strength is used as a single decision parameter. The experiment was carried out between June and November of 2017 with 100% success. Solution development required the integration of knowledge, processes, techniques, and tools both hardware and software. The applied methodology promoted critical thinking and the development of student's responsibility for their own learning. Students participating on the project experienced the opportunity to work with people who had different cognitive and intellectual capitals, a challenge found most of the time only outside school limits. The collaborative applied method nurtured initiative and risk taking to the process of solving a real-world problem, therefore contributing for a better student education. This work was carried out under the extension project “Promoção da Inclusão Social/Digital de Deficientes Visuais através de Soluções de Engenharia Elétrica”.

Keywords: Bluetooth Low Energy, Navigation System, Real Time Proximity, Transformational Engineering Education, Visually Impaired.

11.1 Background

It is widely recognized in the literature[1-3] the need for transformation in Engineering education. Society’s problems are becoming more complex, broader and are multidisciplinary on their roots. In order to have market value Engineers must identify and solve societal problems whose solution benefit people, specially their quality of life, nonetheless Engineering students focus on facts, tests, and grades and fail to understand concepts and processes. They are unable to integrate knowledge, processes, techniques, and tools, both hardware and software, to solve a multidisciplinary problem. Engineering education is characterized by lecture-mode faculty teaching and passive student learning. The exclusive silo structure deprives students of exposure to all disciplines and the multidisciplinary systems nature of modern Engineering. Clearly a change is needed for faculty and students, in the sense of better preparing students to be 21st century Engineers to tackle society's problems.

11.2 Purpose/Hypothesis

The purpose of this work is to report on how an extension electrical Engineering project can contribute to the transformational Engineering education of undergraduate students. The goal of the extension project is to collaboratively develop a Bluetooth low energy beacon system to promote the safe navigation of the visually impaired in indoor/outdoor environments. Participating in the activity the undergraduate experiences a multidisciplinary learning method which deepens regular disciplinary knowledge while extends that thinking to encompass the importance of interaction within and across disciplinary domains. Furthermore, the student is also challenged to work with people with different cognitive and technical capitals.

11.3 Design/Method

A collaborative method was applied in the project in order to promote a transformational approach in Engineering education. In this method the undergraduate electrical Engineering students experienced informal conversation rounds with social technicians and health professionals, aiming to design and develop a proof of concept which attend all requirements specified in common. The proof of concept consists of a beacon navigation system for the visually impaired. The applied method ensures that the solution reached is not only human-centered but solves a societal problem as well. The informal meetings (conversations) were conducted at the CCLBC in a dialogical cycle fashion where the participants have the opportunity to contribute for the solution's design, construction and testing. This allows the non-Engineers to appropriate technical information by reinterpreting, adapting and reinventing technology use. The undergraduate Engineering students, on the other hand, faced the challenge to transduce non-Engineering knowledge into technical requirements and guidelines for the proof of concept construction. A key aspect of the applied method lies in the development of reference material proper for future solution reproduction which includes operation e construction manuals produced by the social technicians under undergraduate student supervision. The development of this material follows a cycle process as shown in Figure 11.1. A complete description of this method can be found somewhere else [4-5].

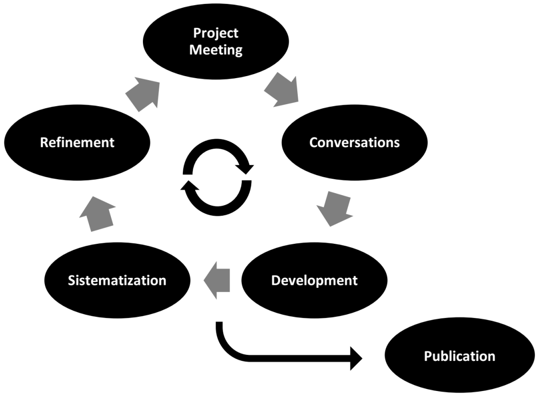

Figure 11.1 – Reference material production cycle.

11.4 Results

A hardware/software android system which enables communication of relevant location-aware information to a blind person carrying a Bluetooth enabled cell phone was successfully developed and installed at CCLBC in Campinas. Figure 11.2 shows the intensity (RSSI) footprint mapping of the beacon system signal after optimization for minimum message interference in the three-floor unit. The app used a priority message system scheme to further avoid messages conflicts.

Several project situations promoted the development of multidisciplinary skills and competences. Table 11.1 lists some of the worked Engineering attributes.

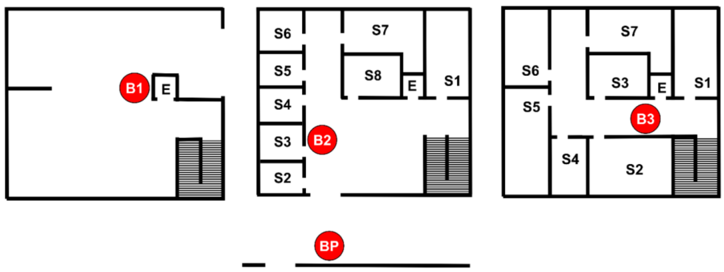

Figure 11.2 – Beacon optimized position in the three floors and entrance gate of CCLBC.

Table 11.1 – Some of the worked Engineering attributes.

Attribute	How
Critical thinking	Decision on what type of telecommunication technology used considering applicability
Immediate action	App deployment in two weeks after final requirements definition
Integrative vision	Architectural design considering interpersonal and organizational skills while combining and implementing their knowledge from different disciplines
Human-centered ideas	Interface and functionality conception based on the visually impaired needs

Cross disciplinary domains	Combination of legal, psychology, communication, arts, computer science, electrical and telecommunication's Engineering knowledge in decision making

11.5 Conclusions

Analysis of the user impressions during the June-November (2017) test period demonstrated a high degree of the system's acceptance by the visually impaired. This came as a no surprise since the system was collaboratively developed. Nonetheless some work remains to be done to increase the messages granularity so that a finer ambient description can be achieved. Participating in the extension project allow the students to better develop their skills and competences to face the 21st century professional challenges by promoting multidisciplinary aspects of Electrical Engineering education.

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CHAPTER 12

Interdisciplinary Projects Involving Engineering and Veterinary Courses Expanding Borders of Engineering Education

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Abstract: This work reports an experience involving Interdisciplinary Projects between Engineering and Veterinary students. As part of a live-stock replacement policy, students from both courses working together built a representation of a dog circulatory system. The model consists in a representation of a heart and veins made with LEDs controlled by an Arduino, programmed to show the heart pumping the blood to cells and lungs, where the blood oxygenation occurs. This project seeks insert the student as an active subject of the teaching-learning process and promote the engagement of teachers from different disciplines and areas of knowledge. In the process of learning, for the establishment of new mental connections, it is important to consider two aspects: continuity - process in which the student relates the previous knowledge with the new ones, that is, the teaching is supported in already existing cognitive structures; and the rupture - a process that is installed in the presence of new challenges proposed by the teacher and that surpass their experience.

Knowing that these processes are essential, the need for interdisciplinarity, which will make it easier for the student and the teacher, to understand and practice certain subjects and the role of each one of them in this scenario. For the students of Veterinary Medicine the understanding of the physiological processes and the fact of explaining their needs to the students of Engineering, constituted a significant pedagogical gain. From the elaboration of visual mockups, the understanding about the functioning of the organs grows. In formulating explanations of the phenomena to colleagues from another area, the elaboration of reasoning reaches the levels of deep learning. For Engineering students, we can say that there was an engagement to seek more knowledge of the area of physiology and anatomy, showing a proactive attitude to solve problems that extrapolate their area of training. In addition, there was an interaction between the students of both courses, which is very important in the training of professional integrators who need to communicate and act in several areas. Stimulate creative power, autonomy, integration and group work among students and teachers, promoting interdisciplinarity. Promote the discussion of innovative topics for the undergraduate course, with a critical and reflective basis.

Keywords: Active Learning, Interdisciplinarity, CDIO, PBL, Project-Approach Education.

12.1 Background

This work was developed during 2017 as a requirement for 4th and 5th semesters Engineering students, as part of Interdisciplinary Project discipline. Engineering students were invited by Veterinary team (including teachers and students) to develop an electronic devices and systems to replace live-stock material and create solutions for classes demonstrations.

Since 2015, Engineering courses at Universidade São Judas adopted CDIO framework[1] in Project classes for its simplicity and easy comprehension by students and, at the same time, a complete structure for academic projects. In this discipline, classes are tutored by a teacher that weekly meet students, working in groups up to six people, to follow, instruct and discuss their projects.

In CDIO, projects are divided in four stages: “Conceive”, “Design”, “Implement” and “Operate”. During the semester, for each step there is at least one deliver, that will be assessed by the teacher, composing the final grade.

Due to a live-stock replacement policy, veterinary teachers and students presented the idea that Engineering students create devices and system to didactically represent animal parts. Veterinary students advised future Engineers in represent important organs and systems.

12.2 Purpose/Hypothesis

The main purpose was to develop Engineering projects in which students build animals and organs didactic mockups. For specific project related here, a mammal circulatory system was made using CDIO as project approach.

All hardware controls were made using an Arduino platform, and allows to exhibit in a dog model the a simplification of a circulatory system. In the first part of project (in 4th course semester) normal circulation were represented. In 5th semester, students implement circulatory systems malfunctions.

12.3 Design/Method

Initially, Veterinary and Engineering teachers build a “Project Canvas” to clarify goals, deliveries and assessments[2].

From canvas, classes and other support activities are planned, in this case instructions from Veterinary teachers, as well as a visit to anatomy lab were scheduled. Project was divided in two major phases, one for each semester, one for model building and normal circulatory demonstration and one for understand and programming usual malfunctions in circulatory systems of mamos.

In “Concieve” phase, one group of students decided to build a representation of a mammal circulatory system. This is a didact representation for

Veterinary students to understand normal blood circulation in animals as well as its malfunctions.

In "Design" step students sketched a dog model that was used to represent mammos and established Arduino as this software/hardware platform. "Implementation" and "Operation" phases were divided in two semesters, each one with their own goals and assessments.

12.4 Results

During two semesters, Engineering students had the opportunity to use their knowledge to solve issues in a different area and the experience to work in interdisciplinary teams. In general, students had a good comprehension of the goals and project management techniques, such as weekly report, partial delivers and seminars, were applied with good results.

12.5 Conclusions

As part of important skills for 21st century worker[3], flexibility and work in interdisciplinary teams. In addition to elaborate a didact equipment, which will help students of the Veterinary Medicine course, Engineering and Veterinary students had the opportunity to expand their knowledge in another area. In addition to facilitating this contact between teachers and students with different knowledge and mind-sets, the work has added soft skills (work in interdisciplinary teams, systemic vision, problem solving, creativity) and are serving as a model for other actions in projects involving different areas.

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CHAPTER 13

Education for Sustainability at The Polytechnic School of Pernambuco

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Abstract: Increasing concern about negative environmental impacts demands sustainable practices, and, therefore, professionals able to collaborate with the Sustainable Development (SD). Sustainability requires Engineers not only training to establish problem-solving techniques but also the ability to identify problems, and, thus, propose appropriate and effective solutions. During the University years, students are able to actively experience, build, and practice knowledge, skills, and principles of sustainability as part of their professional identity and formal education. For this reason, principles of sustainability must be incorporated into Engineering undergraduate programs, and High Education Institutions (HEI) need to revise and change their educational models. The purpose of this paper is to identify courses related to sustainability in the Civil Engineering (CE) undergraduate program of the Polytechnic School of the State University of Pernambuco (POLI/UPE) and compare them with the related courses of the best CE undergraduate programs in the Northeast of Brazil. Initially, a bibliographic research was carried out to identify aspects related to the importance of sustainability teaching in the scope of Engineering undergraduate programs, at national and international levels. Then, a docu-

mentary analysis, carried out in May 2017, allowed obtaining and detailing information regarding the 17 programs considered in this study. From the results, we noticed that 29.4% of the 17 programs do not offer courses related to the teaching of sustainability concepts and applications. Undergraduate programs with content related to the study of sustainability totaled 10 courses. Regarding POLI's CE curriculum, we observed that only two required and one elective courses address issues related to sustainable development, concepts of sustainability, and social responsibility of the Engineer. It can be concluded that there has been a shortage of courses focused on teaching sustainability. For further research, we suggest a continuous work with other Brazilian HEI, contacting Engineering departments or undergraduate program coordinators. For meaningful learning outcomes, these topics should be incorporated into various undergraduate courses in order to guide the students on how to integrate sustainable concepts and practices into their professional life.

Keywords: Curriculum assessment, Civil Engineering, Undergraduate programs, Syllabus, Sustainability.

13.1 Background

Sustainability requires Engineers able to develop problem-solving techniques. These professionals must be able to identify the roots of the problems [1] and propose appropriate and effective solutions by analyzing a wide range of their consequences. Engineering education communities recognize the importance of Education for Sustainable Development (ESD), training young Engineers with technological knowledge and skills to solve problems in a sustainable way [2]. Given the growing concern about the negative impacts from Engineering practices on the environment, probably all Engineers will come into contact with problems that require sustainable solutions during their career. In these terms, the competence of Engineers who are delivered to the labor market will potentially have a major impact on society [3]. For this reason, Universities play an important role in social change and should include concepts and practices that follow the principles of sustainability and SD. To meet the demand for SD, in the United States [4] and in the European Union [5], new curricula are being proposed to improve the understanding of Engineering students. In order to sustainability principles be incorporated into Engineering undergraduate courses, HEIs need to revise and change their educational models. It is during their University years that students are able to actively experiment, build, and practice knowledge, skills, and principles of sustainability as part of their professional identity and formal education [6]. Consequently, the ESD curriculum must be open, negotiated, and co-constructed [6], involving the local community and creating spaces for transdisciplinary reflection and education, flexibility and adaptability.

13.2 Purpose

The purpose of this paper is to identify courses that approach aspects of sustainability in the curriculum of the CE Undergraduate Program of the POLI/UPE and compare them to the best Civil Engineering undergraduate programs in the Northeast of Brazil.

13.3 Method

This is an exploratory work based on bibliographical research and documentary analysis [7], aiming to explain problems, improve ideas or discover intuitions. The bibliographical research aimed to deepen the aspects related to the importance of teaching sustainability in the scope of Engineering undergraduate programs, at national and international level. Then, the documentary analysis allowed the obtaining and detailing of the information about the 17 courses that were part of this study. Based on data from the e-MEC system of the Brazilian Ministry of Education [8], the best Civil Engineering programs in the Northeast region were selectedi, considering the ENADE [9] concept. Posteriorly, a study was carried out regarding the availability of curricular programs or pedagogical projects for the 17 courses from 15 other HEIs and POLI/UPE. Through the analysis of these documents, we identified the presence or absence of content related to the concepts and applications of sustainability and SD. Only the courses that contemplate concepts and applications of sustainability were considered. Therefore, courses such as “Environmental Education” or “Environmental Management”, which did not have those specifications in their syllabus, were not classified as sustainability teaching subjects, given that sustainability is composed of three dimensions (environmental, social and economic), and to be achieved it is necessary to incorporate the three elements [10], not only the environmental one, for example. To be included in this study, courses should describe topics such as “Sustainable Development” or “Sustainable Construction”, for instance. After this analysis, sustainability-related courses were characterized by the individual analysis of their syllabus, which were collected in May 2017, from the website of each department or in the pedagogical project of the undergraduate course, when this document was available.

13.4 Results

Considering the 17 CE undergraduate programs selected in this study, we found that 29.4% did not offer courses related to the teaching of sustainability concepts and applications. It was not possible to access the curriculum of 4 programs. The 8 programs that presented courses related to sustainability teaching totaled 10 syllabuses analyzed, which include topics on sustainability and SD. The CE Undergraduate Programs of the Federal University of Alagoas; Federal Institute of Education, Science and Technology of Sergipe; Federal University of Campina Grande (UFCG); and the State University of Santa Cruz presented more than one course focused on sustainable practices. It was possible to infer that from the total, 60.0% are required courses and 50.0% are offered in the second half of the programs. From the analysis of the syllabus, it was observed that topics range from initial concepts about sustainability to application with a specific focus for the study area. We also noted that, with the exception of one course, sustainability concepts are presented in parallel with other subjects, such as: construction quality indicators, environmental management system, ecosystems, environmental education , building materials and project cycles. It is worth highlighting the elective course "Sustainable Development" of the CE Program of the UFCG, which proposes to present contents that cover all dimensions, indicators, and sustainability indexes. As for POLI/UPE, only two required courses were found, both from the first period of the Civil Engineering program (Introduction to Engineering and Sociology and Environment), which deal with issues related to SD, concepts of sustainability, and Engineers' social responsibility. It was also found the elective course Advanced Topics in Engineering B: Sustainability Applied to Constructions (SAC), whose syllabus includes current development model, national and international standards related to sustainability in construction, and application of social sustainability in construction, among others. SAC also contemplates 15 hours for University extension activities through which students apply scientific knowledge to the local reality, developing the ability to understand and transform the space around them.

13.5 Conclusions

From the results, we perceived the shortage of undergraduate courses focused on the teaching of sustainability. It is important that courses introduce sustainable concepts and actions that target the SD, such as green building, sustainable planning, energy saving, and solid waste reduction. When entering the labor market, the Engineer should be prepared to deal with potential problems related to the three dimensions of sustainability. Thus, it is necessary that, since the freshman years, students take courses that contemplate the principles of SD. In light of this, we suggest to include elective and required courses that highlight the importance of the subject for future professionals. For significant learning outcomes, these topics should be incorporated into several undergraduate courses in order to show the students how to integrate sustainable concepts and practices into their day-to-day life, regardless their field of work.

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CHAPTER 14

Strategic Board: Test The level of Knowledge about Other Countries

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Abstract: This article presents the process of creating a board game called "Strategic Board - (TE)" held in the second semester of 2017 in the discipline of Logistics in the Electrical Engineering Course of the Federal University of Goiás (UFG). Creative process management, Design Thinking, such as brainstorming and prototyping. Supported by the concept of gamification to create a game to support teaching and training in a playful way. The inspiration for the game was board like Profile, Academy, Master, War and the animated film Operation Present. The theme of the game is Geography/Curiosity. In order to win the player must conquer as many "territories" as possible, represented by the houses available on the board, answering questions related to world geography and curiosities, and using strategy to block the advancement of opponents. The board design was developed to enable different sequences of moves, allowing movements for all directions; the player is free to choose the best move. Another differential is the possibility of customization of the questions, allowing the used game to be used with other questions and or used for company training. Applied research using the game's prototype revealed that the design is innovative for 80% of respondents, 20% partially and 0% considered without any innovation.

Keywords: Strategy, Game, Logistics, Gamification, Design Thinking.

14.1 Introduction

The Strategy Board (TE) is a board game for four players. Inspired by classic board games such as Perfil, Master (which have as element the answer of questions), the game War (which has as element the conquest of territories) [1], and in the animated feature "Operação Presente" (which chronicles the competition of three generations of Santa Claus in a race to deliver more gifts). Where these players must answer questions of world geography and conquer more territories, demarcated on the board to win.

The game was created in the discipline of Logistic Planning, using Design Thinking [2] method to stimulate the creative process, supported by the concept of gamification, which means the use of games for another purpose [3].

The goal of creating the game is to exercise the knowledge of other countries' curiosity through questions, as well as to stimulate the competitive instinct of the player, by encouraging the creation of strategies to beat their opponents[2] [3]. Given the freedom for players to explore the tray. Therefore, players would be free to explore in every way.

The game was developed thought in range between 7 until 17 years but not restrictive. Using as a constituent element of questions and answers together with exploration of territories, that is, a junction of two or more styles of classic board games. The formulation of the questions in the charts as well as the strategies of the game were developed to help the basic knowledge necessary for the training of students between the proposed age range, using the contents applied in primary and secondary schools in Brazil, so that the game could aid in school reinforcement while it is being used. The game has 64 questions 4 pawns, each player represented, and one dice, which defines how many houses each player can move per round. In addition to allowing customizations to be applied for learning other content and for training.

14.2 Purpose/Hypothesis

Teach in a fun way about world geography/culture, stimulating a practical and easy way to play and using concepts of gamification [3], which favors learning through elements of games allied to educational contents [4]. Enabling students, from the game, to have thirst for knowledge and curiosity to learn beyond: encourage strategic thinking; and enable adaptations.

14.3 Design/Method

The applied methodology was gamification, applying the principles of games to improve the engagement and participation of users [3] along with Design Thinking, process of production of innovation through the creative management of projects [2].

The creation of the game was due in stages marked by processes. The first process was that of Brainstorming performed through group discussions, and teamwork.

The second process was the creative generation of ideas[1]. Applied to test game alternatives generated in the previous step. This process made it possible to arrive at the problematic for creation of the game, the teaching of world geography.

Later with the game logic ready, entered the third process, the prototyping stage, which consists of creating an object model that will be built in order to reduce costs and minimize failures. The use of prototyping made it possible to evaluate the game and thus create a game by testing in terms of gameplay, design and mechanics.

The prototyping method has been broken down into stages from low-fidelity prototypes made through paper sketches to high-fidelity prototypes, already printed with the layout and objects of the games ready to test the gameplay and thus arrive at a final result. The Board used as an inspiration board game as Profile and Master: question/answer game [3] and the animation film Operation Present [5], with elements of territory conquest and strategy. These inspirations influenced our design and through it, we chose to use a globe to show the countries. The colors used were thought to retain the attention of the players through color searches that capture the attention.

14.4 Results

The survey revealed that 100% of the respondents consider that the game has totally systemic vision, partially 0% and 0% none. 40% of respondents considered that the game offers total encouragement for decision making, 60% partial and 0% none. The rules are completely clear to 100% of the respondents, 0% consider partially and 0% is not clear.

The design is totally innovative for 80% of respondents, 20% partial and 0% considered without any innovation. 40% of respondents consider that the game has total harmony between its elements, 40% partial and 0% none. The theoretical foundations are totally intrinsic to 20% of respondents, 40% to partially and 40% to none. 20% of those surveyed consider the theme of the game totally unknown, 60% partially and 20% not new.

14.5 Conclusions

The game proved to be well built achieving good results, in the test evaluation of this was identified that the design; offers stimuli for making decisions, the rules are clear, enabling a systematic view of the game very good.

In addition to the assessments of the game point out that this is a great way to complement curricular learning.

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CHAPTER 15

Common Engineering Students' Difficulties with DC Electric Circuits in An Inquiry-based Laboratory

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Abstract: It is well known in Physics Education literature that some difficulties of the students with direct current electric circuits concepts remain even after attending to Introductory Physics. Our group have been researching this laboratory for more than 10 years, looking to students' difficulties and proposing an active learning instructional material. In 2006, we adapted a question developed by McDermott and employed it to investigate students' conceptual understanding of electric circuits in three states of Brazil. The research involved students from calculus based Physics course and the question was applied after students attended to theoretical and laboratory courses. To answer the question, students had to order light bulbs according to brightness in three different electric circuits. The fact that typically 13% of students answered correctly agree to result in other countries and inspired us to restructure the

laboratory. We developed a new guide where part of the activities were adapted from Tutorials. With the new guide the average percentage in the post-test improved significantly to 47%. We also have been using the Determining and Interpreting Resistive Electric Circuit Concepts Test (DIRECT) as assessment. After analyzing the questions, we proposed many modifications in the students' guide and some of them we managed to improve, like those related to resistance and current. Along the years, we were able to help students overcome known conceptual difficulties with the proposal of new activities. Our experience has shown us that research for improving practice is fundamental to overcome persisting difficulties and is a long-term and constant action.

Keywords: Electric circuits, Inquiry, Laboratory, Undergraduate.

15.1 Background

Literature showed us that there is a necessity to transform teaching methodologies, to contribute with the formation of professionals well prepares for the technologic challenges of the XXI century. Bradley (2001) says that the Physics laboratories should be structured in a way that allow students to be active in their learning process while making experiments [1]. However, many times, is observed that students follow a script in which they are not encouraged to think about their own observations. Researches in Physics teaching in the last decades have given special attention to constant current electric circuits (CC), which is studied in high school and in college. It is consensus that students still show some conceptual difficulties, even after attending to Physics' lectures and laboratories [2, 3]. In order to improve learning of fundamental concepts about CC and add other elements to students' intellectual development, the Electricity and Magnetism laboratory of our institution have been modified, making students active in their learning processes. To do that, we adapted the Tutorials in Introductory Physics [4], according to our institutions norms of time.

15.2 Purpose/Hypothesis

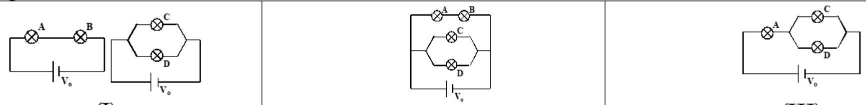
In this work, we compare post and pre-tests in order to identify students' most common difficulties about electric circuits

15.3 Design/Method

The Electricity and Magnetism Laboratory lasts for one semester and has 6 classes, four hours each. In each class, there are about 30 students, divided in 10 groups of three students. They make six different practices along the lab.

The lab guide is composed of questions that follows a sequence of prediction-observation-explanation, in which students build relations between variables

A light bulb is a resistance. If this bulb is ideal, it means that it's resistance is constant e obeys Ohm's Law. Suppose that four identical light bulbs (A, B, C, D) and an ideal battery (V_0), that compose circuits in figures (I, II, III). For each case, classify the light bulbs in growing order of brightness. Explain your reasoning.



(I) (II) (III)

Figure 15.1 – Question adapted from McDermott (1992).

involved in the model studied. At the end of each practice, there is a list of exercises for students to consolidate and improve knowledge. The physics concepts are introduced through the lab and the experiments are made in a growing level of complexity. Students are asked to discuss and register answers to experiments and, if there is any diversion of opinion they also have to register. Doubts related to each experiment or section must be solved (through discussion between group members and monitored by the Teacher Assistant and the Teacher) before proceeding with the experiment. At the end of each practices, students must make a report consisting in their answers to the guide's questions, the data collected and explanations. To evaluate the guide, we applied the same question as pre- and post-test (see the Figure 15.1). The post-test is applied 3 months after the laboratory's experimental practice about CC circuits. We also have applied the DIRECT's questions. Comparing students' answers to pre- and post-tests we can see an increase in the number of students who answered correctly each question. In this way, we could map students' common difficulties and proposed new activities to improve learning.

15.4 Results

The results presented here have been collected from 2013 to 2017. There were a total of 494 students from different Engineering modalities. Analyzing students' answers to the open question, we considered correct only those who gave the proper explanation to their reasoning. In these four years, we had a grown in all the three questions. Another interesting point we observed is that students answer the post-test using more conceptual and argumentative justifications than they did in the pre-test, where answers were based on equations. It shows us that students qualitative argumentation has increased once they built a more complex reasoning.

The DIRECT showed us that the students present greater difficulties in questions about power and work. Power is not treated extensively in our laboratory and the work is not even mentioned. It shows us that we can map the difficulties of students even in lectures on electricity and magnetism, since the student studies them before the laboratory. The same can be said about the microscopic aspects of electric current. For this objective, the variation that we had among the correct answers in the post - pretest was 21%, but only

40% of the students were able to respond correctly in the post - test. Regarding questions about power and work, the variation we obtained was 2%, where only 25% of the total students were able to respond correctly. In addition, it demonstrates how research is a good way to improve learning, as we have mapped the difficulties of the students ten years ago and propose activities to help students overcome them.

15.5 Conclusions

In this work, we analyzed students' answers to pre- and post-tests where we could identify common difficulties in Engineering students about CC circuits. In the open question, we observed difficulties cited in literature, as current being consumed and confusion between current, resistance and voltage. We also noted that student's answers in post-test are more structured in logic reasoning and less in formulae, comparing to pre-test. Through DIRECT, we observed some difficulties persist, like microscopic aspects of electric current and about power. These subjects are not treats deeply in our laboratory but are in the lectures. Thus, we could identify conceptual difficulties from other classes. We believe that the improvements and students' difficulties pointed in this work could serve as impulse to the proposal of new activities and inquiry teaching strategies, seeking a wide students formation.

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CHAPTER 16

Flipping the Classroom: The Application of The Circuit as An Objective Evaluation Action in Foundation Design

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Abstract: The evaluation process is one the most challenging tasks in education because, for many times, the process is subjective, lacks clarity and goals or has a deficient comprehension of its purpose. The circuit is a form of assessment based on the interaction and cooperation between students that aims to verify the results of the learning process through entertaining activities. This paper presents the results of applying the circuit in Foundation Design, an undergraduate course of the 5th-year of Civil Engineering at the Universidade Estadual de Santa Cruz, UESC, in Ilhéus, Brazil, in 2017. The motivation for applying the circuit in this course was to permit the students to work together and share what they have learned with their classmates. By doing so, the professor considered the idea of the Zone of Proximal Development, assessing the students' ability to solve problems with the help of their peers. The method,

although containing many rules, was easy to apply. The students, divided into groups of three, were expected to create two reports based on data for one Standard Penetration Test (SPT) - and one Cone Penetration Test – CPT. Each member of the group had a different attribution, the first one, the Engineer, producing the report, the second one, the technician, completing the missing data of the tests, and the third one, the manager, correcting the final report. After completing the activity, each student pointed out its negative and positive aspects and this information was used to compose the results. From the results, the method showed to be effective because it developed the students' sense of responsibility (73% of the answers), it allowed the students to experience the dynamics of the labor market and was innovative (60% of the answers each). Conversely, it may have failed with respect to the distribution of time (40% of the answers), what may have compromised the results of the groups. Therefore, the method proved to be effective but, for further applications, it still needs some improvements.

Keywords: Circuit, Foundation Design, Zone of Proximal Development.

16.1 Background

The assessment of the students' academic results is one of the most challenging tasks of the educational system [1]. The subjectivity of corrections, the lack of clarity and goals in the applied assessments and a deficient comprehension of the evaluation process reveal that challenge.

Even though many people may believe the traditional evaluation systems are objective, especially on the application of written tests, it can be perceived that these systems tend to be subjective. This subjectivity, which has its own merits, reflex the culture and experiences of the professor on his actions, what is still impregnated by the logic of classification and selection [2].

Regarding the lack of clarity and goals on the assessments, what can be observed is that the school has used the tests' results as a mean to determine the reach of the educational objectives [3]. Therefore, the failure of the students in the evaluation process may represent a result of a deficient practice on the construction and clarification of the criteria used in the assessments.

Thus, the professors must promote a form of assessment that allows the students to become aware of their learning process, what overcomes the traditional evaluation models, which are classificatory and authoritarian. In this way, the tests become a tool that reflects the intentionality of the educational process, not being it, so, the educational process' intention [2,4].

16.2 Purpose/Hypothesis

Collaborative and cooperative learning have been used in academic level given their potential to promote a more active learning that stimulates critical thinking, interaction between students and problem-solving skills.

The circuit is a form of assessment based on the interaction and cooperation between the students that aims to verify the results of the learning process through entertaining activities. The students are divided into groups, and they must solve the proposed problems at the same time they assess the solutions proposed by their peers.

In this sense, the circuit uses the concept of the Zone of Proximal Development, from Vygotsky. Usually, we tend to think the mental development is related exclusively to the ability to solve problems independently, what is called Actual Developmental Level, disregarding the ability to solve these problems with the help of the professor or other colleagues, what is the Zone of Proximal Development [5].

So, this paper presents the results of applying the circuit in a Foundation Design class, a 5th-year undergraduate course of Civil Engineering at the Universidade Estadual de Santa Cruz (UESC), in Ilhéus, Brazil.

16.3 Design/Method

The class of 15 students was divided into five groups of three students each, and the exam was divided into two main parts. In the first part of the exam, the groups had to write and asses a report for a Standard Penetration Test – SPT and in the second part of the test the groups had to write and asses a report for a Cone Penetration Test (CPT).

Each student in the group performed a different role in the activity. The first student was called the Engineer and was responsible for producing a complete report for a SPT in 30 minutes. This student had to produce the report based solely on the data provided by the professor. If the student considered that some data was missing, he would request help and the second student, called the technician, would have to provide the missing data in 15 minutes. The Engineer could not utilize any data that was not provided either by the professor or the technician. In this case, the technician would have to provide consistent data, i.e., provide a value of N for SPT within the range expected for each type of soil, for example. Finally, the third student, the manager, was responsible for assessing the produced report, which would be either accepted, if the manager considered it was all right, or rejected because of incomplete data.

The three students in each group could neither meet nor discuss during the activity, except in the occasion the first student requested it. In this case, the group would give up on part of the final grade.

After each part, the professor assessed the report considering the completeness of the work of the “Engineer”, the data provided by the “technician” and the verdict of the “manager”. Finally, at the end of the class, the professor provided each student with a sheet of paper in which they had to add some comments about the test anonymously. These answers were collected, and the number of similar thoughts were grouped and analysed.

As it can be seen in Figure 1, most of the students, 73,3%, considered that the activity developed their sense of responsibility and more than half the students considered that the activity promoted an experience of the professional practice, teamwork and interaction between students, besides being innovative. Conversely, as it is shown in Figure 16.2, 40% of the students considered that the activity had a brief duration, and some of them considered that the responsibilities of the members of the groups were not well divided and that the grading system was inappropriate.

16.4 Results

Considering the results obtained from the feedback applied, the answers were grouped into positive and negative aspects. Figure 16.1 present the percentages of each of the positive aspects mentioned in the feedback and Figure

16.2 the percentages of each negative aspect.

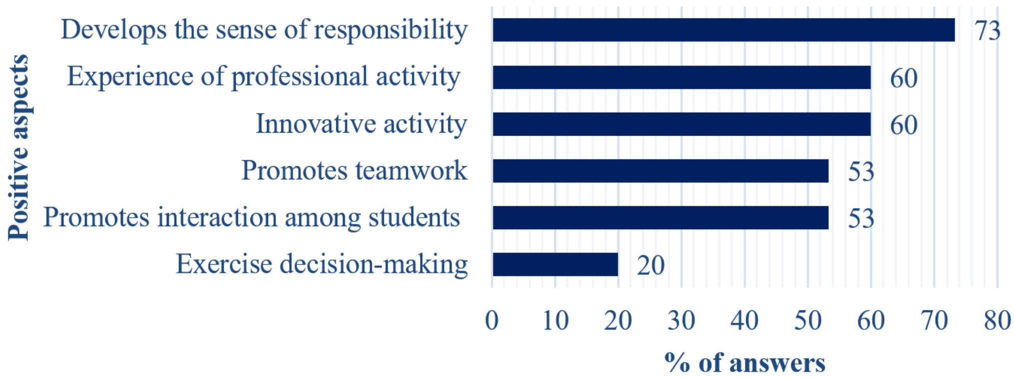

Figure 16.1 – Distribution of positive answers.

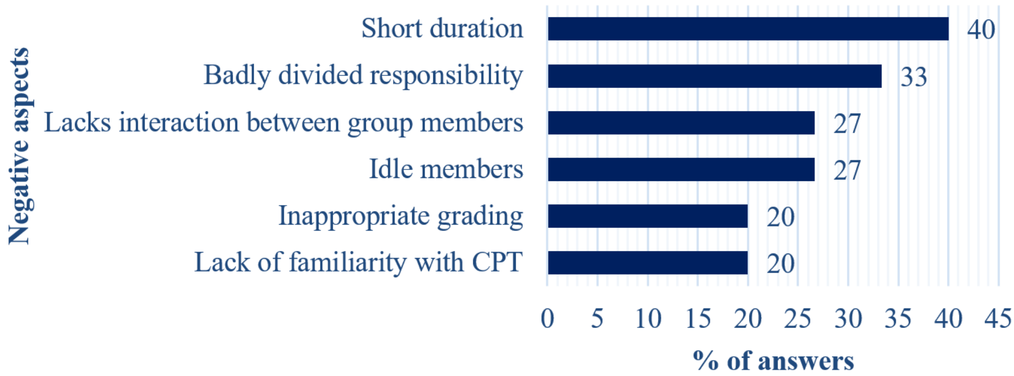

Figure 16.2 – Distribution of negative answers.

16.5 Conclusions

As the results of this paper show, the students in Foundation Design at the UESC in 2017 considered the circuit promising because it explored their sense of responsibility, was innovative, promoted interaction between students and teamwork. Conversely, the students pointed out that the method applied still lacks some features that may be improved in subsequent applications.

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CHAPTER 17

The Acting of The Higher Education Institution in The Accompanying of The Supervised Internship: A Contribution for The Engineering Courses

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Abstract: Brazil's public policies of professionalization recognize the internship as an educational-professional link, supervised and developed as part of the pedagogical project and the trajectory of the student's education. In Brazil there is a law that regulates the student internship on their undergraduate courses. The internship needs to be understood as a powerful source of learn-

ing, as it is a propitious environment of great importance for the exchange of technical and transversal competencies between companies offering internships, higher education institutions and students. However, it is necessary to promote a consistent dialogue between the three parties involved and it depends to a large extent on initiatives of Higher Education Institutions. This work presents a proposal of action focused on the relationship between the following agents: the supervising professional, the trainee student and the tutor teacher. It is being applied to the Course of Electrical Engineering of the Federal University of the State of Espírito Santo, in order to collaborate in leading the student in his trajectory, having as one of the most important pillars supporting the actions of acquisition and transfer of the competencies proper to the professional practice. The intention is to operate in the interfaces between the three agents, promoting a dialogue between the parties and a reflection on the performance of each one of them to establish and stimulate the joint participation of all the agents in the educational-professional process of the student. Therefore, it was decided to develop interfaces in the form of a website to provide efficient ways of communication, containing very objective and easy-to-answer surveys as well. With this methodology, the trainee can receive information about technical contents necessary for the good performance of his activities, as well as a more effective guidance of his supervisor. The supervisor will have the opportunity to know how the University is preparing their students, besides being able to propose programmatic contents and exchange information about the existing limitations and skills that need to be developed by the trainee. There will be a standard routine for completing the surveys by the student and the supervisor. Moreover, there will be a report from the teacher after analysis of the questionnaires, which, if deemed necessary, will promote a conversation between the parties. It is hoped this pedagogical strategy will be able to reveal, for the business part, that it is worth investing in the offer of good internships; to show the student that he should make every effort and seize every opportunity of acquiring skills to become a competitive professional in the current job market and; to show the University that a closer relationship with the business sector can contribute to update the pedagogical resources for the professionalization of students and to establish more research and development partnerships.

Keywords: Education, Internship Law, Supervised Internship, Technical Skills, Transversal

17.1 Introduction

Higher education institutions around the world have invested in research projects aimed at developing teaching-learning processes for students and teachers. One can mention, for example, the learning methodologies based on interdisciplinary projects (PBL - Project -Based Learning) and inverted classroom, among others. However, to the best of our knowledge, the supervised internship has been underestimated as a powerful learning tool. There are some research papers available related to this theme, which have some correlation with the present work [1-3].

Usually, in the Course of Electrical Engineering of the Federal University of Espírito Santo (UFES), the evaluation of the supervised internship carried out by the student is made through regular reports. However, such procedure does not promote closer relations between the parties involved, does not contribute to the transfer of competencies to the trainee and does not lead to a feedback to the pedagogical project of the undergraduate course. Therefore, this paper presents a proposal for an action focused on the supervisor-trainee-tutor relationship. Such action has been applied to the Course of Electrical Engineering of UFES, to collaborate when leading the student in his or her career, having as one of the most important pillars supporting the actions of acquisition and transfer of the competencies proper to the professional practice.

17.2 The pedagogical strategy applied to the supervised internship

The purpose of this research is to operate in the interfaces between the three agents, supervisor-trainee-tutor, promoting a dialogue between the parties, in order to establish a joint participation of all agents in the educational and professional process of the student. The development of interfaces in the form of a website is proposed, containing very objective and easy-to-answer questionnaires. With this platform, paper-based reports will no longer be needed and will benefit the tutor, who can evaluate information, compare results and exchange ideas with trainees and supervisors on a non-face-to-face basis. The trainee can receive information about technical contents necessary for the good performance of his activities, as well as a more effective guidance from his supervisor. The supervisor will have the opportunity to know how the University is preparing students, besides being able to propose programmatic content, exchange information about the skills that need to be developed and the limitations that need to be overcome by the trainee. It is proposed that the questionnaires are applied in three phases, where each one will address different issues. The first phase should happen at the beginning of the internship; Intermediate phase: by the quarter and/or the end of the semester; Final Phase: at the end of the internship. In all phases, there will be a questionnaire to be filled out by the trainee and the supervisor, with a later analysis of the tutor, which if deemed necessary, will promote a conversation between the parties.

The first phase occurs immediately after the internship contract is signed. The first questionnaire will serve as a digital tool for recording the activities, the technical contents necessary for the proper development of tasks, identifying the areas of knowledge involved in the internship practice and the posture that the trainee should have within the environment of work, among others. At this stage, the internship coordinator will assign a tutor who best meets the requirements of discriminated areas of knowledge. The trainee's profile, skills, uncertainties and limitations can be observed. It is possible to check if the work project is compatible or not with the technical knowledge transferred by the academic party so far. The student's goals and motivations will be recorded and, also, if he is aware or not of the skills and competencies that he can develop. A separate questionnaire, with different login and password, is directed towards the supervisor. The idea/goal is to understand what knowledge and skills the trainee is expected to develop in order to contribute to the work accomplished by the company. The supervisor will inform how the company can contribute to the development of knowledge and skills to the student and what technological training opportunities the company can offer.

The second phase starts after the first three months of internship, it is expected that the student is already adapting to the company's routines and procedures. This adaptation phase requires a lot of involvement from the supervisor, helping the trainee to overcome difficulties, take initiatives and to show what the job market expects from a professional. At this point, the trainee has the opportunity to evaluate the management and contributions of his supervisor. It is of great importance to observe if the student is adapting well and showing satisfaction in the progress of the internship. The supervisor should inform if the student is performing well, if his relationship with the team is good and if he is fulfilling his tasks. At this point, the supervisor has the opportunity to suggest to the student possible improvements to optimize the performance and resourcefulness of his work. If there is a long-term contract, other questionnaires will continue to be formulated regularly and the answers will be then compared to previous ones, in order to verify the evolution of the educational-vocational process of the student.

The third phase is aimed at general evaluation; it is the result of all the experience of the trainee in the work environment. The supervisor, knowing the profile of the future professional, has the opportunity to evaluate the skills that became more evident in the student, the skills that need to be worked, which kind of knowledge the student need to acquire, among others elements. The important information at this stage is: understanding the combination of academic knowledge and professional work, positive and negative assessments about the internship, personal and technical growth and meeting the objectives of the internship experience as stated by Brazil's internship law. The contribution of the supervision to the trainee, the difficulties of interpersonal relationships, among others, will be evaluated. Through self-assessment the student will inform if the academic knowledge received was sufficient and useful for the achievement of the challenges faced in the internship and, together with the supervisor, may suggest the offer of specific courses to complement students' professional training. Another very important element will be the student's perception of the awareness he has taken about skills that he will need to develop as competitive assets for the practice of his profession. Finally, the student will be able to confirm if the objectives established by the internship law have been fulfilled. It should be assessed at that point whether the internship really contributed to him regarding his confidence while facing professional life.

17.3 Conclusions

Experience has shown that companies are interested in offering internships for a period of one year, possibly renewable for another year. That is justified by the fact that in the first year the trainee is still learning the work routines and becoming familiar with the team. It is in the second year that he can contribute more to the practice of his functions. The experience of the trainee in the professional environment can be conveniently explored and enriched by the Institution of Higher Education that can promote the closer relations between the involved parties, contribute to the transfer of competencies for the trainee and improve the pedagogical project of the under-graduation course in Engineering. In this context, the methodology proposed by this work is aimed to facilitate the analysis of supervised internship, through an online platform, available to the intern, University and company.

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CHAPTER 18

Business Model for Photovoltaic Systems through Shared Generation: Approach with Design Thinking

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Abstract: The National Electric Energy Agency (ANEEL) regulated the shared generation model by means of Normative Resolution nº 482/2012, where individuals or legal entities can unite for installing a generating plant that uses renewable sources for the production of energy power. In this way, the collective engagement of cooperatives and consortium has adopted the installation of photovoltaic systems as an alternative for the reduction of electric energy costs and the diversification of the energy matrix in Brazil. From the interest of maximize the margins of business through shared generation, it is possible to find in the market today proposals for rent or purchase of lots that use solar energy as a renewable source to generate energy credits, being an alternative for consumers who have some kind of economic or physical roofing limitations.

As attractive, the surplus in kilowatt-hour of energy generated by the photovoltaic system used it to reduce the costs from the electric energy consumption of the participants that mighty be linked to the system of shared generation through the registration of a natural person or a national registry of a legal entity. From this, the work aims to evaluate the different forms of entrepreneurship in the photovoltaic solar energy market, and how these types of businesses can generate a capacity of technical efficiency compatible with an economic viability that meets the common interests of a consortium or cooperative that uses the generation shared by means of photovoltaic system. The methodology for analyzing this shared distributed generation business model will be through Design Thinking, which has tools such as map of empathy and the algorithm proposed by Minkowski. The purpose of this analysis is to meet the need of Brazilian society in an innovative way to promote solutions that bring well-being in the lives of the people involved in the process.

Keywords: Business, Cooperative, Consortium, Design Thinking, Solar Energy.

18.1 Background

Today, when you think about innovation, there is no way companies can continue to use methodologies that aim only at economic performance. New ways to succeed in the pursuit of business survival need to be traced.

Methods such as those of Geoff Nicholson ("Father of the Post It") where "innovation is transforming knowledge into money" [1] are incomplete for the current requirements of competitive markets, since approaches that have innovation as objective need to be focused on the needs of well-being of the human being.

An invention that is close to your ideal and uses a strategy for its application can only be considered an innovation if your customers recognize the value of your entire investment. From this, the sense of innovation in the business sector can not try to solve problems with the same thoughts that created them.

But in order to circumvent statistical assumptions and pressure for immediate results, project management must revolutionize how to find innovative and creative solutions to the real problems of the market.

Thinking about it, Design Thinking was created from the result of the search for innovation, so that its approach is focused on the human being and its multidisciplinary is able to lead to innovative solutions for different types of business.

The approach evaluated here in this article, Design Thinking, comes to verify how valuable the idea of unraveling "Cartesian thoughts" can be, in order to provide an innovation that not only leads us to think "out of the box", as well as , mainly meets human needs by introducing new meanings to products and services offered in the renewable energy market that use as a source of solar energy.

18.2 Purpose/Hypothesis

Focusing on the development of new technologies and the opening of new markets, companies in the solar energy segment started offering photovoltaic systems in the form of leasing, renting or leasing. Thus, ANEEL Normative Resolutions No. 482/2012 [2] recognized shared generation projects capable of uniting a group of people and companies with the objective of generating energy and dividing the credits among the members.

To try to understand how these companies created new business models for the solar energy segment, while new markets were built to meet social needs, Design Thinking was the approach used in our research to assess how increasing The scale of a solar energy project reduces the unit costs of the implantation of a photovoltaic plant, as well as the practice of commercial leasing has made possible in urban centers the popularization of photovoltaic systems in houses and commerce.

18.3 Design/Method

In order to meet people's needs in reducing their spending on electricity bills, the Design Thinking approach was used to identify the various business models of photovoltaic systems. Through a Preliminary Immersion [3] the study group carried out Desk Research [3] and Minkowskie [4], which allowed a clinical view of the problem to establish new value propositions for these business models. The reframing made it possible for those involved to idealize two new market segments to be served by companies operating in the field of solar energy: Installation of Centralized and Decentralized Models. The first is characterized by the formation of a Participating Quota Society (PQS) [5] for the installation of photovoltaic plants in remote locations textsuperscript6, while the second model is characterized by the practice of financial leasing [7] for installation of the smaller photovoltaic system on roofs of houses and shops.

A graphical visualization was proposed to organize the data that were mapped during the Analysis and Synthesis phase[3]. In this way, the business models were filled with complementary information every time the work group had some Insight. This visual collaboration allowed the structuring and correlation of the research data during the six collaborative meetings.

18.4 Results

The Figures 18.4(a) and 18.4(b) demonstrate the two Canvas models developed for the business models during the Thinking Design Group meetings, respectivaly: the Product/Service Maps; and the Business Model Tables.

The results obtained from the Preliminary Analysis[3] were compared with the results of the Immersion in Depth phase[3], allowing the formulation of the first Canvas for the cases of centralized and decentralized photovoltaic plants, which led to the formatting of the products/services through a conceptual map, identifying the characteristics of the team responsible for the service, the details of the advantages to surprise desires and needs, and the support to solve negative experiences of the target audience. A description was also proposed to characterize the target audience, containing the following information: consumers' needs and desires, their socioeconomic classification, their habits and lifestyles, decision makers in the purchasing process, and the detailing of experiences negative.

The second Canvas has led us to identify for each model the information about: key activities to be carried out, resources and partnerships for the delivery of the product/service, the origin of the financial revenues of the two business models, the communication channels for dissemination, the price values to be offered, the investment relations, the target audience map, the distribution channels and the map of products and services.

18.5 Conclusions

As can be seen, the methodology used in the approach proposed in this article covers a wide range of important notes on the construction of a new model or idea for the solar energy market, taking into account not only the product itself and its technical needs that will from the project to the installation, as well as the most important part of this market: the consumer and the investor.

What sustains a particular product or service is nothing more than supplying a need or a dream, the driving force of the human being. Without losing sight of an excellent management, one can not lose sight of economic, logistical and legal planning. Since Design Thinking works in order to align these very important areas for any enterprise and the CANVAS illustrates well the situation pointed out.

In both models, we can see that in both cases we were able to reach the objective of this work, to meet the needs of the target public by proposing photovoltaic systems at low cost, without loss of product quality/service and at the same time ensure a light bill savings. Since in the first model we can satisfactorily map how an increase of scale of the project can contribute to the reduction of the cost of implantation of a centralized photovoltaic plant, by diluting its monetary value among the other participants of the project. While in the case of leasing practices it is possible to allow the sale of smaller photovoltaic systems, in a decentralized manner in urban centers and for affordable values, guaranteeing an economy in the consumption of electric energy. However, in order to be able to offer photovoltaic systems at the lowest price and high quality of product/service, it is necessary that in all cases there is always the figure of an investor that makes it possible to raise funds for the project. The same holds true for companies operating in the solar industry, so these companies can also invest in business models by using their own resources.

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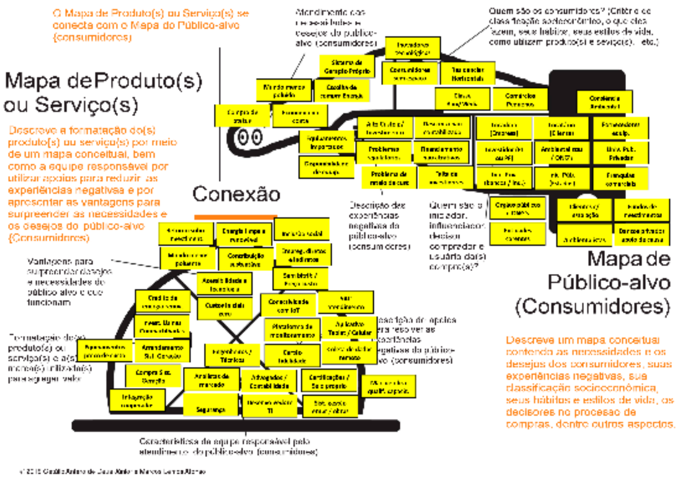
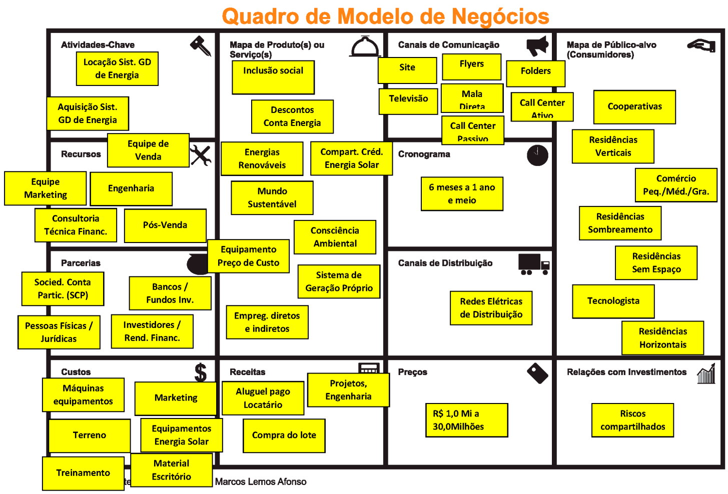


(a)



(b)

Figure 18.1 – Canvas models developed for the business models: (a) Product/Service Maps; and (b) Business Model Tables.

CHAPTER 19

Evaluation and Implementation Proposal for A Methane Gas Generator Using Solid Waste

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Abstract: A waste or garbage is any material considered to be useless, superfluous or worthless, generated by human activity, unwanted and discarded in the

environment, where once collected, the waste can be disposed of in landfills or destined for composting, incineration and recycling. Reducing the impact of economic activities on the environment is a reality today and is no longer just an issue for ecologists. It is necessary to avoid that such a large volume of waste continue to be released into the environment, polluting sources, soil, air, as they not only affect the quality of life of rural and urban populations, but also the survival of flora and fauna in the regions where the creators are inserted. In recent years there has been a resurgence of interest in biogas capture due to growing concern about global warming. The use of biogas to generate electricity causes a reduction in the potential for environmental pollution, since the mixture composed of a marked concentration of methane gas (CH4) is burned, about twenty (20) times more polluting than the dioxide of carbon (CO2), with regard to the greenhouse effect. The use of biodigesters has deserved important importance due to the aspects of sanitation and energy, besides stimulating the recycling of nutrients. Since the entry into force of the Kyoto Protocol there has been renewed interest in biodigester technology. The biodigester is an equipment where organic matter fermentation takes place in a controlled manner, providing the reduction of environmental impact and the generation of fuel of low cost. The fermentation of the residues occurs through the action of microscopic organisms (bacteria). Thus, considering the environmental problems and the possibility of saving natural gas prices, this work has as general objective the evaluation and suggestion of the implementation of a methane gas generator using solid waste, in addition to a review of the biogas production study reuse of methane gas. At the end of the work is intended to verify the possibility of implementing the project in an industrial kitchen.

Keywords: Waste, Garbage, Environmental Problems, Kyoto Protocol and Biodigester.

19.1 Background

Anaerobic digestion an important role in solid waste management especially considering the rotten organic fraction of solid urban waste. This anaerobic digestion is a natural process that occurs in the absence of oxygen and has as characteristic an organic matter biochemical decomposition by a specific microorganisms' group. This process produces an energy-rich gas, biogas and a nutrient-rich effluent. Therefore, it is a viable alternative for the stabilization process of the organic matter and the energy utilization of this "garbage" with relevant applicability [1]. The use of biogas as a source of energy production from digestion of the organic fraction present in solid wastes and sanitary effluents represents a great social and environmental benefit, mainly in the big urban centres due to the reduction of the final disposal in landfills and the reduction of the organic components of effluents as well as decrease in pollutant emissions, such as methane, a greenhouse gas that corresponds to up to 70% of biogas [2].

The use of biodigesters has deserved important highlights due to the aspects of sanitation and energy, besides stimulating the recycling of nutrients. Since the entry into force of the Kyoto Protocol there has been renewed interest in biodigester technology. The biodigester is an equipment where organic matter fermentation takes place in a controlled manner, providing the reduction of environmental impact and the generation of fuel of low cost. The fermentation of the residues occurs through the action of microscopic organisms (bacteria). The process of decomposition of organic matter results in the production of biogas [3].

19.2 Purpose/Hypothesis

The main goal of this work is an evaluation of the use of a biodigesters to recovery the methane gas from solid waste, as well as the proposal to its implementation in a community kitchen. In addition, for the construction of the biodigester it is necessary to evaluate which model is the most appropriate for the type of garbage produced by the kitchen in order to propose a qualitative analysis through the monitoring of the process to analyse the quantitative characteristics of the biogas produced, in terms of CH4.

19.3 Design/Method

The development of this work presents the proposal to study a biodigester model for low cost gas generation, starting to the process of decomposition of the organic matter resulting in the biogas production and unscented digested remains (biofertilizer). We will calculate the daily volume of the mixture and also the total volume of the biodigester. It will also be analysed the time of Hydraulic Detention, time required for anaerobic digestion of the mixture, when the maximum gas production occurs, defining the point of better biogas quality in the anaerobic bio digestion process. The time of detention is determined in a continuous process by the relation between the volume of the digester and the daily volume of the introduced load, that is, of added organic matter. The hydraulic detention time and the efficiency of the biodigester will be obtained as a function of the inoculant used.

In the first stage, for data collection, the study is being carried out in the unit of the social project (Programa Vida Melhor - PROVIM), located in the city of Lorena – SP where are being collected the information of total weight of all organic matter processed during the studied period, as also as the information of amount of waste discarded and the number of people who the restaurant weekly attend during the measured period. In the second stage, will be determine the biodigester theoretical size based on the average daily solid waste during the studied period. The daily average of solid waste is represented by the sum of the disposed organic residues, the inoculant, the buffering and the mixture moisture content [4].

19.4 Expected Results

According to the study, we aim to find the ideal biodigester model and design for the studied site, presenting a possible amount of biogas generated from the solid waste and the appropriate analysis methods for the study process. After defining the ideal digester structure, we will have the volume and size dimension necessary for the biodigester to be adequate to consume and produce methane gas from this waste. With the study of the data collected for the construction of the biodigester we also intend to avoid unnecessary expenses with the addition of materials and equipment that would not bring any advantage to the bio digestion process. In addition to avoiding unnecessary expenses, defining the ideal model of the biodigester, we intend to avoid the low production or insufficient gas for burning common difficulty in the biodigester projects producing methane gas recovered from the waste.

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CHAPTER 20

Operations Management Implementation in A Small Food Company

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Abstract: This work presents the application of the concepts of production and operations management, storage and demand management, and material resource planning in a small food business, which did not have any type of productive or financial control, and it was possible to observe the results and the opportunities that can be provided in the long term, through the optimum use of material resources, machinery and manpower, as well as enabling the company to new markets. In addition to presenting the application of the concepts of production and operations management, the main goal is to promote the financial recovery of a small food company, in a situation close to bankruptcy, through the implementation of the concepts of production planning and control, control of stock levels of raw material and finished product and financial management. And finally, to reach the goals were implemented an WSB system to manage of raw material storage levels and finished goods also; production standardization using news operational requirements and defining the costs of raw material, production operation and sales.

Keywords: Production Management, Operations Management, Storage, Demand and Costs.

20.1 Background

The modern world is made up of various types of organizations, without which modern society could not exist [1]. However different organizations may be, they all have similar activities, such as marketing, accounting, people management, logistics, and production activities. Production activities exist and need to be managed in any type of organization1. In this modern world with the constant advancement in technology, the emergence and improvement in concepts of production management and globalization, companies that do not follow the evolution along its trajectory tends to lose market share, once its finish goods are produced with a high cost compared to other companies or by failing to meet the needs of its customers with regard to delivery time and/or product quality. Due to all market factors that influence the demands and prices of products, production planning, inventory management and cost control becomes even more essential for small companies with a non- automated productive process.

Therefore, this work shows the implementation of Engineering concepts developed during the Industrial Engineering course at Salesian University Centre of São Paulo in a small food company, which have not had any type of productive or financial control. After the new requirements implementation, was possible to observe the immediate results in the organization and the opportunities that were provided through the better use of the raw material, the machines and the workforce, in addition, it was possible to qualify the company for new market possibilities.

20.2 Purpose/Hypothesis

The main purpose of this study is promoting the financial recovery of a small food company in a hard situation very close to bankruptcy through the implementation of the concepts of production planning and control, raw material level management, finished goods management and financial management. To achieve the main objective, it was necessary to create and implement a WSB system for the management of levels of raw material and finished goods storage, to standardize production through the development of operational requirements and training of employees, as well as to define the costs of raw material and finished goods costs and the sales prices.

20.3 Design/Method

The company's performance was divided into three stages: (a) data collection and analysis; b) Engineering concepts implementation observing the necessary corrections; and (c) analysis of results.

The first data collected were related to costs. The company produces large sugar candies in packs of 150g, 100g, 75g and small sugar candies in packs of 150g, 90g, 75g, and based on historical owner data, each production batch of large sugar candy should yield 4,5 kg or 360 large sugar candies, but at the end of the two months of data collection it was found that there was gap of 35%

between the total that was to be produced and the actual production. Considering the nominal weight of the packages, each large sugar candy produced should weigh 12.5 g. In order to verify the effective candy weight 150 samples were weighed daily of packages with 12 units (150g), and the Figure 20.1(a) shows the results before the Engineering requirements and the Figure 20.1(b) shows the results after the Engineering requirements.

Considering all the data, it was possible to conclude that, in addition to the non-existence of working capital, the company was suffering from poor utilization of productive resources and, consequently, its sales volume was affected, failing to make a profit. To correct the process, we conducted training with production employees to demonstrate overweight in products and explain how important it was to the company to make better use of material resources, considering how much the company's outcome was being affected by inefficient production.

20.4 Results and Conclusions

The adjustment in the purchase of raw material allowed the company to use less daily capital and better control of the use of resources, in addition to avoiding losses due to storage. With the decrease in the weight of the sugar candies, it was possible to increase by 15% the quantity produced by lot. The decrease in the weight of the sighs allowed the possibility to increase by 15% the quantity produced per batch. Considering that there was no increase in the quantity of raw material used neither in the workforce cost, this production improve was reflected almost entirely in the company's results, since the inputs needed in production and packaging have a low cost. In view of the need for the company to have a working capital reserve, based on the market condition, the owner was advised to separate this amount for at least 6 months in order for this objective to be met.

In this project it was observed that the maximization of profits of a company does not depend exclusively on investment in expansion or modernization of its production line, as well as the importance of production control and management, regardless of the size of the company. Knowledge of the product structure, lead time for the delivery of raw materials and inputs and the development of suppliers able to meet the necessary quality and time allowed the company to plan with excellence the use of its resources and, together with a line of efficient and controlled production, maximized its profitability, which compares to the productive efficiency of large sugar candy, by comparing to the weights of the 12 units packages (150 grams) before and after the adequacy of the production process. Finally, another important point was the frequent monitoring of demand behaviour. In the case studied, the company works in a comfortable situation, since it operates at its maximum capacity and there is no stock of finished product because the demand is greater than its supply, however, if there were loss of customers or change in market behaviour, all the planning would be redone so that the control of the expenses was not lost.

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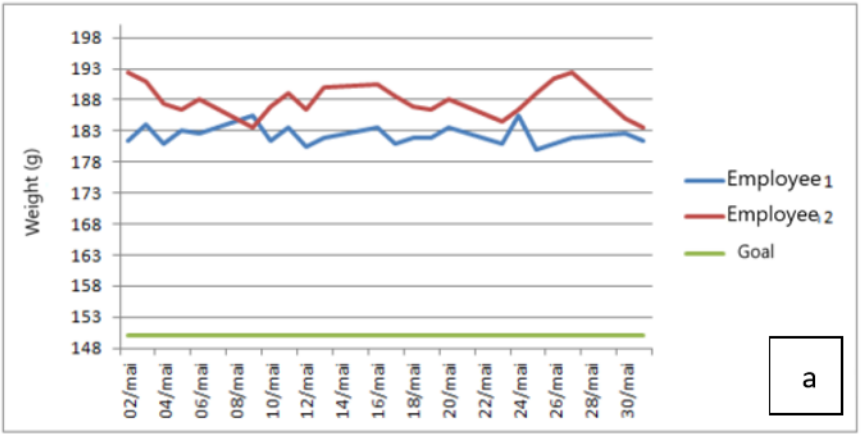
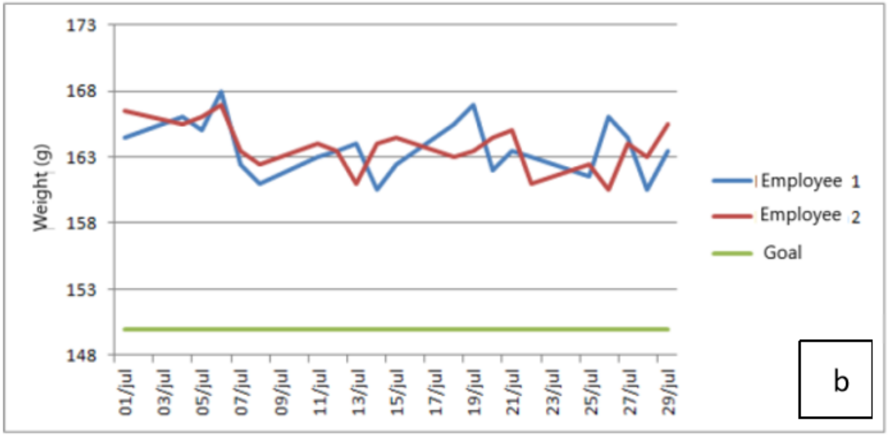


(a)



(b)

Figure 20.1 – The results before (a) and after (b) the Engineering requirements.

CHAPTER 21

Homemade Beer: Academic Enterprise

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Abstract: A Beer is a non-distilled alcoholic beverage obtained from the alcoholic fermentation of malted cereal wort, usually barley malt. The origin of the first alcoholic beverages is uncertain, but probably have been made from barley, dates, grapes or honey. Beer was already known by many ancient civilizations and was popular in climates where it was not possible to grow grapes.

Most cereal drinks in the last 8,000 years are considered beer. The invention has been attributed to the Sumerians and Egyptians, both civilizations having produced an alcoholic beverage for more than 5,000 years. The people of northern Europe discovered the technique of brewery not long before the Christian era. To date, some beers in this region have a slightly acid taste, indicating the development of lactic fermentations. The monks have perfected brewing technology and served, in a way, as wholesale sellers. The homemade beer market in Brazil has presented annual growth between 30% and 40%. Home brewing today represents 1% of the national brewing sector, but according to the Brazilian Beverage Association (Abrabe), the trend in growth should lead the country to reach 2% of the beer market share in ten years. In the second quarter of 2016, the number of breweries registered in the Ministry of Agriculture increased from 320 to 397. The current craft beer market in Brazil is seeking local, organic, differentiated products that have a history, there is a need for new tastes and new experience, and do not just want what comes from large, large scale, low quality companies. The practice of homemade brewing not only opens the door to the emergence of new breweries, but also creates business opportunities for the supply of raw materials and equipment. This research project aims at the idealization, planning and execution of a business plan for the complete artisan brewing process, seeking alternatives to raw materials, processes and manufacturing and equipment, in order to make its implementation simple and with low cost making it possible to enter the beverage market.

Keywords: Industrial Engineering, Craft Beer, Teaching Methodologies and Methods and Process Control.

21.1 Background

The craft beer market in Brazil has presented annual growth between 30% and 40%. The homemade beer today represents 1% of the national brewing sector, but according to the Brazilian Beverage Association, the trend in growth should lead the country to reach 2% of the beer market share in ten years. In the second quarter of 2016, the number of breweries registered in the Ministry of Agriculture increased from 320 to 397. The current craft beer market in Brazil is searching local, organic, differentiated products that have a history, there is a need for new tastes and new experience, and do not just want what comes from large, large scale, low quality companies. The practice of craft beverage production not only opens the door to the emergence of new breweries, but also creates business opportunities for the supply of raw materials and equipment. This research project aims at the idealization, planning and execution of a business plan for the complete artisan brewing process, seeking alternatives to raw materials, processes and manufacturing and equipment, in order to make its implementation simple and with low cost making it possible to enter the beverage market. In Brazil, beer is the alcoholic beverage with the largest market share, since it came to the country around the 17th century, brought by the Company of the East Indies, along with the Dutch. With the departure of the Dutch from the country in 1654, the product disappeared for almost 150 years, reappearing only in 1808, when the Portuguese Royal Family landed in Brazil Colony. From this event, some pioneer brewing initiatives were carried out by immigrant families, but only for their own consumption [1].

21.2 Purpose/Hypothesis

The present work shows that it is possible a production of quality craft beer using the minimum equipment and raw materials. It is expected with the final results that the craft beer elaborated can be commercialized in the future. The work as well as shows an elaboration of a Business Plan for brewing, in order to make its implementation simple and low cost making it possible to step into the beverage market. The work was developed following same simple steps: project design and planning, definition of beer type, brewing process planning, evaluation and definition of the best brewing process and evaluation and definition of the operation costs. Further of the practical development of the project. The way of establishing a business of its own gives a new career perspective in which the entrepreneur has control of the business from the outset and that its power is increasing as the company grows [2]. The first recipe proposed for elaboration was a Weiss style beer, it is a beer of creamy foam, soft bitterness and aromas of clove and banana. Generally it is a type of beer that does not go through the filtration process, because some of its yeast remains deposited in the bottom of the bottle, giving the type a cloudy appearance when served.

21.3 Design/Method

The BIAB (Brewing in a Bag) method is an easy method for brewing artisanal beer, as it requires few equipment for its use. The method is based on the use of a bag, in which the ground or powdered grain is added, this bag is then immersed in the brew pan containing hot water for the brewing stage. After the blast process, where the malt compounds are extracted, the bag is removed, the wort that remains in the pan after the blast is already clarified since the bag acts as a filter, making it impossible to pass large particles of malt. In a traditional brewing process, three brewing pans are required; in the case of using the BIAB method, only one brewing pan is necessary, hence its practicality while being economical. One of the biggest disadvantages of BIAB is efficiency compared to other production methods. It is not uncommon to have efficiencies in the 50-

60% range. However, with some techniques it is possible to achieve efficiencies comparable to more traditional forms of brassage, between 70% and 80%.

21.4 Results/Conclusions

At the end of the research project, have made available to the Production Engineering course a robust craft brewing process, with clear scheduling and control of processes at each stage of production and a possible alternative of equipment for entering the beer market craftsmanship. It is expected with the final results that the craft beer elaborated can be commercialized in the future.

It is known that one of the major disadvantages of the BIAB method is efficiency compared to other production methods. Its efficiency is at 50% to 60%. However, with some techniques it is possible to achieve efficiencies comparable to the more traditional forms of brassage, between 70% and 80%, this is undoubtedly one of the crucial points that was discussed, for the next brew will be adopted the most effective process for the washing of and finally, a more effective way to sanitize the bottles for the container will be adopted, since this factor may have influenced the final carbonation of the beer. Finally, we searching for a contribute to science, in the sense of enhancing academic training, fostering interest in research, contributing to the expansion of knowledge.

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CHAPTER 22

Extracurricular Activities: Analysis of Its Influence and Relevance

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Abstract: In Brazil, the academic curriculum offered in undergraduate Engineering courses is focused on teaching primarily the theories and techniques necessaries to meet the basic needs of professional Engineering practices. However, the professional market requires skills from the new Engineers which are not presented in their regular curriculum. Among the requirements, it can be

pointed out the following skills: communication, teamwork and mastery in problem solving techniques. In contrast of that trend, the Polytechnic Association (PoliUFG) was created at Federal University of Goiás, Goiânia, Brazil, in 2015, formed by students from several Engineering courses from the University itself. The Association aims to carry out initiatives complementary to those offered at the academic institution and it is legally characterized as a Non-Profit Civil Association, with its own statute and independent management. In order to fulfill one of its objectives to establish an approximation between the professional market and the University, PoliUFG created the Market Week. This event, which lasted four days, is formed by lectures given by local big companies owners and CEOs, workshops, technical visits besides bringing to the University internationally renowned companies such as AmBev, Cargill, Kraft Heinz, Monsanto and P&G. This experience provides to the students not only a professional experience preview but also a perception of the skills that the job market requires. In the 2017 edition of the Market Week, the Net Promoter Score (NPS) methodology [1] was used to evaluate the importance of this type of event in three different categories: University, students and the professional market. This evaluation showed, with satisfaction, the achievements of the event, as desired by the organization, among them, the development of soft skills and the contact with the practical area of Engineering through the participating companies. It was also possible to observe how much the students are inter-

ested in this type of event, since a significant number of participants assessed it with high importance and recommended to friends, besides saying they would return to attend the event in the next year. The results also allowed to infer the high impact of promotive initiatives, such as the Polytechnic Association, in undergraduate courses. A conclusion of this study points out that students who participate in institutions such as PoliUFG or attend to their events are more likely to be attuned to what is happening in the professional market than a regular student who goes to the University just to attend classes. This fact is shown by numerical analysis extracted from the NPS, a survey answered by the students and the companies at the end of event.

Keywords: Education, Engineering, Extracurricular Activities, Job Market, Soft Skills.

22.1 Background

Many contents taught in Engineering courses nowadays are based on studies developed in the last century. However, this fact has been changing because companies and the society are requiring Engineers with expertise far beyond the theories taught in the classroom. As a consequence, current Engineers are seeking to develop new skills like teamwork, which implies good communication and problem solving. This is the reason why some students have been focusing on their capabilities and skills to innovate, lead teams, manage companies and by doing that, complementing their abilities beyond what is learned in the classroom.

In addition, it is seen that this new way of thinking the job market requires a professional who has a universal education and not just technical knowledge. It is a fact that some Engineering students have already realized that. A search for contents within the University that helps them improve their soft skills increased significantly in the last few years. The students know that this type of knowledge will not come from inside the classroom, so they seek to close this gap by joining selected student institutions and participating in special extracurricular activities [2].

By recognizing the needs and importance of these changes, an event was held in Goiânia, within the Federal University of Goiás (UFG), Brazil, aiming to establish an approach between the job market and the undergraduate students. The event called "Market Week" sought to complement the education of such students by promoting an exchange of information between the companies and the Engineering students. This was the first event of its kind, and provided an opportunity that former students did not have the chance to experience. The event held in October 2017, lasted four days, offering not only presentations but also workshops on negotiation, finance management, entrepreneurship and leadership. It also provided technical visits to large companies and lectures and tips on multinational companies admission processes such as AmBev, Cargill, Kraft Heinz, Monsanto and P&G. This event was completely idealized, organized and executed by Engineering students.

22.2 Purpose/Hypothesis

This work presents an experience for developing soft skills for the future Engineers during their undergraduate studies. Besides that, it aims to evaluate how the type of event such as Market Week can affect the students performance due to the interaction with the professional market by complementing their knowledge.

Summarizing, this research aims to study the impact of extra class events in the Engineering students' professional formation at UFG. It's important to emphasize that the knowledge about the event in analysis was considered an excludent criterium, in order to achieve the most accurate evaluation possible [3].

22.3 Design/Method

The Net Promoter Score (NPS) methodology was used to perform an analysis of the impact of the event in its various instances. In essence, the NPS aims to measure the satisfaction and "loyalty" of the target audience to a particular company. Thus, an adjustment in the method was necessary to achieve the main objective of this article.

By doing so, a change was made inte the NPS algorithm. First, the customer loyalty to a company was not analysed, and the effective calculation of the NPS (promoter customers - detractors) was not made1. Second, the results of the NPS of the Market Week of 2017 were not compared with those of the 2016th edition of the event.

Finally, a categorized questionnaire was developed for each one of the target audiences: students, faculty and lecturers (professionals who work directly in the market and company owners), where the students were divided into participants and organizers. These questionnaires contained both general and specific questions.

Students were asked about the personal relevance that events of this nature have in the various aspects of their undergraduate studies and professional choices. They were also asked on the multiple aspects this kind of event develop or motivate development on their abilities.

Questions were also asked to the members of the faculty, about the importance of organizations such as the Polytechnic Association, as well as events such as the Market Week, during undergraduate studies, as a way to stimulate contact between students and the Engineering market as well as their academic development in general.

22.4 Results

In synthesizing the data from the questionnaires about the Market Week, results were tabulated in four different categories: participants, organizers, lecturers and faculty.

From the participants:

- 93% of students would indicate the event to friends.
- More than 40% have not had any previous contact with professionals in the Engineering area.
- The general score for the event was 8.5.
- In average, the importance of initiatives such as Polytechnic Agremiation was 8.4.

From the the organizers:

- Questions related to personal transformation had an average grade of 8.6.
- Questions about the importance and contribution of Polytechnic Agremiation and Market Week to their undergraduate years had an average grade of 9.44.

From the lecturers:

- The average of the lecturers' grades was 9.8.

From the faculty:

- Considering only the faculty members who knew Polytechnic Association, the average grade for the importance of its work to enhance the learning experience of the students was 9.0.
- Besides that, the faculty, in average, considered that the interaction between students and the companies was 9.4.

22.5 Conclusions

The contextual analysis here undertaken is limited, since it considered only one University, one student organization and one event. In spite of this limitation, the results clearly show the positive potential impact that organizations, such as Polytechnic Agremiation, and events, such as the Market Week, have on participating Engineering students.

Therefore, it is extremely important that institutions with this purpose are created within the University environment and events are organized in order to enhance the students vision of their Engineering programs.

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CHAPTER 23

Development of A New Portable Guitar: Linking Innovation and Undergraduate Teamwork

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Abstract: The constructivist spiral approach conceived by LIMA (2017) consists in constructing knowledge from simple tasks with general applications before facing a complex and specific assignments. Knowledge can thus be seen as a spiral staircase, in which a person is always at the same spot but moving up towards a more complex level. Based on this approach, the Laboratory of Innovation, Prototyping and Simulation (LIPS), located at Federal University of Minas Gerais (UFMG), teamed up undergraduate ENGINEERING students coordinated by a professor to solve contemporary problems focusing on innovative education having the spiral approach as a guideline. Travelling with a stringed instrument can be very cumbersome to musicians due to its volume and weight. This study evaluates the possibilities of making a totally functional electric guitar with enhanced portability and earphone compatibility to eliminate the need of an amplifier, which adds more volume and weight to carry. In the process, the ENGINEERING team applied the educational constructivist approach together with concepts of physics and mathematics to evaluate the problem. Afterwards, the development of their own functional and lighter guitar prototype, named Minitar, was conceived relying on ENGINEERING softwares for 3D modelling and programming languages, such as C#. In this process, the team developed new abilities and insights by accomplishing the goals of the project. The idea for the project, its evaluation and an early prototype started mid 2017 by the first author of this paper, and the remaining

work was completed a year later by the team. A functional prototype was therefore built from scratch relying on different sources of knowledge by our multidisciplinary team, hence validating the constructivist spiral approach as an organizational and educational framework. This particular result can be used as an example to further improve the ENGINEERING education in Brazil and also be used as inspiration for educational researches elsewhere.

Keywords: Constructivist Spiral Approach, Engineering, Innovation, Multidisciplinary, Music.

23.1 Background

Art and Science have strong connecting bonds, and sometimes those are underappreciated [1]. Bearing that in mind, a research team consisting of undergraduate students from different Engineering areas was formed to undertake a study with this profile in mind.

Our team, supervised by one of the authors (E.C.V.), developed the Minitar project at the Innovation, Prototyping and Simulation Laboratory (LIPS), a multidisciplinary environment. The main goal of the project was to explore relations between music and Engineering in order to build a functional prototype to cope with the demands of musicians. By doing so, our team applied practical Engineering concepts at an early stage of our undergraduate studies in conjunction with the constructivist approach set forth by [2], as a guideline for the different stages of the project. In accordance with Lima (2017), the tasks underlying a prototype increase in complexity over time and as our undergraduate team advanced towards the final goal of the project a higher level was achieved in the spiral staircase of Lima´s approach.

23.2 Purpose

The main issue to be solved is the considerable volume of a normal electric guitar to make the instrument more convenient for transportation. As a starting point, the dimensions of usual guitars were taken as a reference. We considered several possibilities to accomplish an instrument that should be easier to carry and as functional as a standard one.

23.3 Design/Method

Our initial researches contemplated guitar manufacture techniques and theoretical knowledge required to accomplish a functional prototype. Concerning the fabrication processes underlying the construction of an electric guitar, we needed first to cope with woodworking. In addition, we had to find out the pieces that make a guitar work. Considering our lack of experience with wood work and in creating a product with a high quality audio output, our focus wasn't to learn the whole job of a Luthier at its finest to accomplish an artwork, but instead to create a prototype which could demonstrate a concept.

Afterwards, we analyzed all the physics knowledge needed [3]. The spaces between frets must be correctly defined so that every note will be in tune once the instrument is assembled. The dimensions for a standard guitar neck were easily found, however, no formula was available to calculate them for an alternative neck length, so that we needed to develop an appropriate formula. Mathematics and physics are quite useful in this regard. After some research, we wrote a program in C# (language chosen for a matter of convenience) based on an algorithm that calculates the distance of the frets at once, as shown in Figure 23.1.

This algorithm, described in accordance with T.H. Cormen's book "Introduction to Algorithms", 3rd edition, MIT Press, 2009, can be easily implemented in any high level programming language [4]. Its output is a ".txt" document that enables the user to correctly position the frets on the guitar neck.

We were thus able to place the frets in our 3D model. After all details of the instrument were considered, we designed a 3D virtual prototype relying on SolidWorks 2015 before proceeding with manufacture and assembly. In Figure 23.2(a) is displayed an image of the prototype at its early stage and a more advanced version (see the Figure 23.2(b)).

Algorithm 1 Cálculo de Casas

```
procedure CÁLCULO DE CASAS(input, v, f, d1, d0, fls)        ▷ fls = 329.6
    d0 ← (input/100)
    f ← fls
    v ← (2 * d0 * f)
    d0 ← (d0 * 100)
    intj ← 0
    while j <= 24 do
        d1 ← (100 * v)/(2 * f)
        Write(j, d0 − d1)
        f ← (f * 1.059463)
        d0 ← d1
        j ← j + 1
    return .txt    ▷ O resultado é um documento texto com a posição das casas no braço.
```

Figure 23.1 – Algorithm to calculate pauses between frets, based on the length of the strings.

23.4 Results

Having the spiral staircase as a guideline, we gathered knowledge on simple tasks performed by luthiers and were able to accomplish a first prototype (see the Figure 23.3). This first version was made from recycled and cheap material, so we could easily demonstrate the concept without having to invest too much time and resources at this early stage.

The next version of our prototype is under way and, according to our schedule, will be completed soon. This more advanced version will include electronic

(a) (b)

Figure 23.2 – 3D model of the first (a) and more advanced guitar prototypes (b).

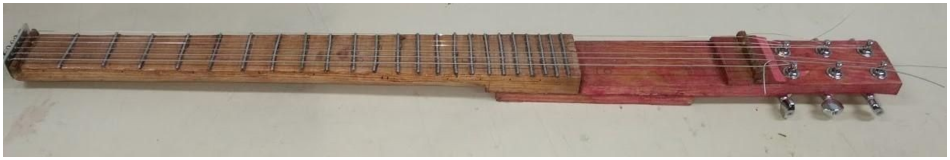

Figure 23.3 – First guitar prototype built from scratch.

parts, new design and mechanical features such as a support for more comfortable use of the instrument.

23.5 Acknowledgements

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CHAPTER 24

CDIO as Project Management in Engineering Courses: Conceiving, Designing, Implementing and Operating Educational Projects

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Abstract: The CDIO (Conceive, Design, Implement and Operate) framework has a great adherence within Engineering education, mainly when acting with project-based approach activities and practices. In Universidade São Judas Tadeu, every semester, Engineering students must develop interdisciplinary projects in which they are able to work applying the knowledge and skills are being taught in order to solve problems that resemble and/or are inspired in real world situations. These projects get more complex each semester once students acquire more competences and experience. Aiming to keep a consistent and structured approach in all these projects, students apply the CDIO framework as a tool for project management, where they should understand the problems presented in some given situation (conceiving solutions), and then designing e evaluating possible solutions (developing and analyzing strategies) that should be implemented (prototyped) and tested, keeping register of each step and being analytical through the process. Every semester, students learn new tools and techniques that are added to their work in these projects, and their role changes from a more passive posture (in first semesters where most of the work is led by teachers) to a more inquisitive and autonomous posture while the course develops through time. In this process CDIO poses as one of the main conductors where these new tools and techniques are aligned and get means

to achieve project goals. CDIO, as a pedagogical approach for project management, has propitiate a good understanding of other professional project management methodologies, making an easy transposition to PMI (Project Management Institute) with its matrix of process groups and knowledge areas or Scrum (Agile Methodology) with its backlogs, artifacts and phases. An important aspect of using CDIO is that students have been satisfactorily achieving the proposed project goals, being able to construct solutions, facing difficulties and solving them, demonstrating understanding and confidence during the process, and more than technical skills, students have also demonstrated development in soft skills, needed in solving the problems and constructing solutions.

Keywords: Active Learning, CDIO, Interdisciplinary Teaching, Project-led Education, Project Management.

24.1 Background

Engineering and projects are closely related[1], once several situations and approaches in Engineering problem solving can be understood as projects, allowing the application of its theories and practices, in this manner, Engineering courses should teach students, in some degree, about projects, its characteristics and management.

In Universidade São Judas Tadeu, Engineering courses have, since 2015, in every semester, an interdisciplinary project discipline where students should analyze a given situation and solve it through the construction of some solution based in theories and with physical implementation[2] (functional prototype) – a project.

In the first semesters of these disciplines students are more tutored by teachers who present simplified contexts in a more conducted approach, but, according to the students' development, the projects are broader, more complex and more realistic, presented in a more open approach, allowing students gradually act in a more inquisitive and autonomous fashion. During all times projects are inspired in real world situations, but in latter semesters they are presented without "filters" once students should have developed some competences in Engineering problem solving and projects[3], demonstrating solutions with the use of best fit instruments and theories. Usually, the graduation project is the last project they do, where students propose and solve an Engineering situation.

24.2 Purpose/Hypothesis

Interdisciplinary projects are presented in four different types: directed, themed, competitive and free. Each semester, teachers discuss and adopt a more suitable type in order to attend established learning objectives.

Directed projects act on specific problem-led situation, where the theme and the methodology are set previously and given as instructions to students. Themed projects do not specify how to solve a problem, but in which area this problem is placed. Competitive projects could be directed or themed, but the results are compared among several solutions. Free projects usually are chosen by students to attend their own interests, and validated by a teacher or a group of teachers.

According to semester progression students are presented to new project management tools and techniques that are added to the previous ones, increasing the controls according with the complexity of projects. In this way students are continuously learning and applying new knowledges and skills[4], while improving their competences', as shown in Figure 24.1.

In this complex scenario, with different levels and approaches for projects that are developed in dozens of classes with over 5.000 students, CDIO (Conceive, Design, Implement and Operate) framework was chosen to accommodate all these project concepts and direct the tasks that should be done in

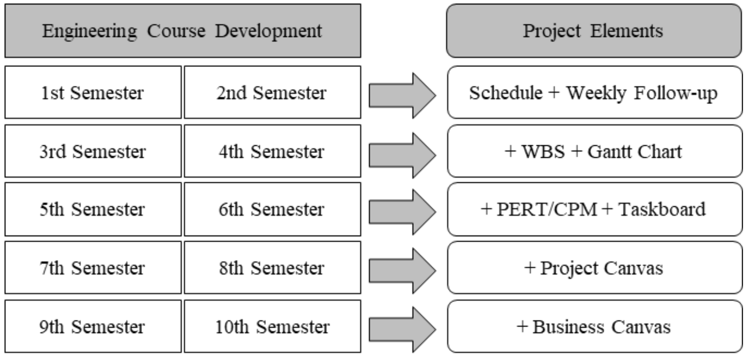

Figure 24.1 – Relation between Engineering Course development and project elements.

order to construct real solutions. The methodology proposed by CDIO foster project development since first semesters until the graduation project, introducing and complementing PMI (Project Management Institute) and Scrum methodologies in Engineering applications.

24.3 Design/Method

The first stage in CDIO methodology is the Conception, where students should research and discuss about a theme and the possible solutions for a given situation. Then students should organize ideas and design a plan to solve the problem, proposing a functional prototype which will resolve the situation. In the implementation phase such prototype should be constructed and tested, in order to be applied and operated in the last stage of CDIO5.

The several project elements are used in the management of the project in each phase of CDIO. In the first semesters students receive the documentation fulfilled and only apply them in their tasks. Once there is advance through semesters, students begin to analyse and develop their own documentation, using CDIO as a guide to organize all the needs of the project.

The conceiving phase of CDIO is experienced by students since the very beginning of course, with more experience and knowledge, students start matering the design phase and so on, until they manage to completely apply this methodology, autonomously: identifying problems and creating solutions for them. The Figure 24.2 shows the taskboard organized by CDIO Phases.

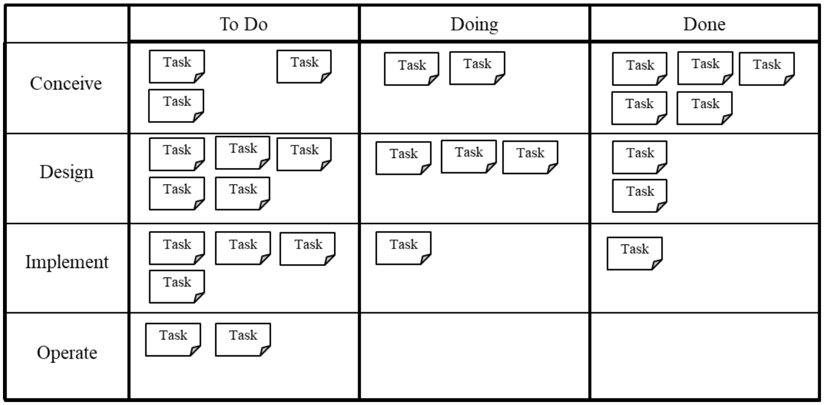

Figure 24.2 – Taskboard organized by CDIO Phases.

24.4 Result

CDIO proves to aid teachers in the organization of their classes as students understand the organization of a project, efficiently applying knowledge and skills in order to solve Engineering problems. Students demonstrate confidence and competence in understanding a problem and proposing solutions which are developed by Engineering projects.

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CHAPTER 25

Soft Skills Teaching for Contemporary Engineering Careers: A Experience Report

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Abstract: Engineering career demands solid technical skills and, usually, courses in this area provide a necessary scientific and mathematical background that support deep understanding and development for specific contents and skills in Engineering fields. Despite all the efforts for a needed technical formation the contemporary professional scenario asks for more. Several educational institutions have realized that some soft skills are central part of Engineers' formation. Since 2017 all Engineering courses of Universidade São Judas Tadeu have been redesign in order to add disciplines that address these competences by present, apply, discuss and develop contents, skills and attitudes towards a socio emotional perspective. There was created a specific course called Integrated Learning Laboratory (ILL) focused in soft skills and life project, but aiming professional development. This course occurs in the first two semesters of Engineering courses with presential encounters supported by online materials and activities in a gamified platform. In the next semesters students are supported by this online platform: Virtual Integrated Learning Laboratory (VILL) which provides deepening understanding in some major areas. At the lasts semester's students will have access to a coaching attendance. Six main axes were defined in order to develop students' soft skills: Identity (in perspectives of personal, social and professional identity), Problem solving, Creativity, Communication, Critical thinking and Diversity. In each semester three of these axes are approached by means of workshops with active learning

methodologies where students learn about them and their application, practicing and discussing the impacts in the specific Engineering career. In the first semester (Identity, Problem solving and Creativity axes are developed) the main focus is in the understanding what means to be an Engineer and what kind of activities are developed in daily basis by this professional. In the second semester (Communication, Critical thinking and Diversity) the focus is in the understanding of professional contemporary scenario. Besides ILL courses there are also some project-approach and institutional disciplines through Engineering courses where students expand their understanding and skills, providing a rich environment where technical skills are developed alongside with soft skills as group work, collaboration, inclusion, ethics, self-knowledge, communication and more.

Keywords: Active Learning, Blended Learning, Engineer Education, Interdisciplinary Teaching, Soft Skills.

25.1 Background

Professionals acting contemporaneously have to demonstrate more than technical skills [1]; this is not different in Engineering area. Technical knowledge, abilities and the so called hard skills are really important to this professional, but nowadays the soft skills have been understand as an indispensable part of their profile [2], approaching socioemotional aspects. Engineering courses should reflect this professional reality, bringing soft skills to its curricula. In Universidade São Judas Tadeu since 2017 was introduced a couple of disciplines in Engineering courses which address these topics, they are known as Integrated Learning Laboratory (ILL).

These are not stand alone disciplines and they are connected with students' individual life project. A purpose of these disciplines is to support students' reflection and planning of a unique project of self-development that will direct some choices students can do during their courses and also in their careers. In order to do that, these disciplines are conducted mainly by Engineers who mentor [3] and support students development.

25.2 Purpose/Hypothesis

The ILL disciplines have triple focus [4], but the three of them aiming professional development, which is the main concern of higher level education: The personal focus (where I understanding myself and my motivations), the professional focus (where I understanding my profession and career) and the social focus (where I understanding myself as an interactive and social being, living in society). All of these three focuses are entangled and represent different dimensions of the same subject.

These disciplines are also organized around six main axes: Identity, Problem Solving, Creativity, Communication, Critical Thinking and Diversity. Each axis represent a fundamental ability professionals should demonstrate in the 21st. Century [1].

ILL disciplines occur in the first two semesters and are competence-based [5], instead of content-based, meaning that the learning objectives of these disciplines are skills and attitudes that are supported by knowledge and contents, but not driven by then.

In the first semester of ILL students learn about only three axes: Identity, Problem Solving and Creativity, looking for the meaning of to be an Engineer, by understanding what kind of activities and duties are developed in daily basis and what forges a unique professional. In the second semester students learn about: Communication, Critical Thinking and Diversity, reaching the understanding of contemporary professional scenario and relationships through social networks, medias and other communication channels.

In each semester students should construct part of their life projects, reflecting topics studied with their career and specific Engineering area [6]. The life project is presented in a specific document: Life Project Canvas, designed specifically to support reflections and develop register of career planning.

25.3 Design/Method

The ILL disciplines are divided in two major types of classes: Workshops and Mentoring, both of them conducted by active methodologies of learning, mainly. In workshops the classes are designed to develop competences instead of contents, so they are structured with experiential practices and activities. In each semester the main axes are developed by means of activities who lead students to experience situations where they should apply studied knowledges, skills and demonstrate attitudes. Aspects as digital literacies in information, medias and technologies as well as accountability, social interaction, flexibility, autonomy, leadership and other skills are addressed in these classes. Mentoring classes are more reflexive [3] and are conduct mainly by discussions and debates, trying to connect the studied competences (in the workshops) with Engineer careers.

In order to support students development was created a gamified online platform, the Virtual Integrated Learning Laboratory (VILL) where students have several activities organized around the six main axes and divided in "stations" who congregate similar issues inside each axis.

The evaluation of students learning in these disciplines is based in the learning process as well as the outcomes deployed [7]. There are four major aspects adopted as assessments in these disciplines: attendance in classes;

participation in activities developing satisfactory deliverables; online activities in VILL and preparation of a learning portfolio.

25.4 Results

In the first moment, when adopted the ILL disciplines, there was around 1,500 students supported by around 30 trained teachers. There were resistances by students that understand they are losing technical content and by the teachers, mainly those whose that do not participate in these disciplines, once they are afraid of been forced to change their teaching method. Another point of resistance was the active methodologies of learning, because students and some teachers thought these approaching were too ludic, with some level of fun and little learning.

With the execution of classes and people experiencing then, besides some communication campaigns, clarifying the objectives and explaining the ways these disciplines should be conducted, students begin to perceive the goals and benefits of these classes. Teachers also understand better the methodologies and how important it has been to students' development.

There is today already some resistance, but the majority of students and teachers understand and support these disciplines. For students is important that teachers of these disciplines are Engineers, and it is also important that these teachers explain and contextualize these discipline in Engineering careers. For teachers was important they perceived that these disciplines have some demands and that teachers should have affinities with them in order to teach ILL, just like happens in other disciplines. Training the teachers shown as a fundamental aspect of success, and today more than 150 teachers are trained in ILL disciplines.

25.5 Conclusions

Although it was a new paradigm in Engineering courses and curricula, asking for intensive planning, training and communication campaigns, ILL has shown as an important improvement in Engineering careers, helping students to best fit contemporary labor market.

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CHAPTER 26

Integrating Practice and Theory into Basic Graduation Courses in Physics: The Current Stage of Implementation of The Laboratory of Didactic Innovation in Physics (LIDF)

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Abstract: This article is exposed as a continuity of a proposal of a applied

research focused on the basic physics disciplines for the undergraduate Engineering courses of the Institute of Technology in the Federal University of Pará (UFPA). The Laboratory of Didactic Innovation in Physics - LIDF - (acronym in Portuguese), is composed by a multidisciplinary group of professors: physicists, Engineers, undergraduate and graduate students. Its main goal is to design and present new educational products and innovative ways of teaching and learning physics for the courses of the natural sciences and Engineering. LIDF is a multifunctional and multiuser laboratory that seeks to produce innovation with the focus on student training that meets the multiple demands of contemporary society. In this article we proceed with the steps of clarifying the characteristics of the LIDF, which includes: delimitation of lines; underlines; educational products resulting from it, taking into account educational-pedagogical demands as well as managerial demands. The group of researchers and students connected to the laboratory deal with the following research branch: Development, adaptation and validation of educational products for physics teaching. It encompasses the development of experimental activities for various approaches and levels of complexity. It also includes development and adaptation of didactic sequences, including evaluation practices, as well as appropriation, application and discussion of results in the investigation of active learning methodologies. An important action field is the support for projects in a similar way to FabLearn Labs, proposed by Paulo Blikstein at Stanford University, which are places that provide diversified tools for the students which can design technological apparatus from the use of these elements. The LIDF works not only to produce instructional resources, but also to contribute to the formation of an educational paradigm aimed at the development of competences by means of educational proposals that unite theory and practice in an indivisible way. In this sense, the laboratory team works with different formats of educational events both for the internal public and for the community outside the LIDF, acting as both initial and continuing training such as workshops; minicourses, etc. As a result of these actions, we highlight the development and successful application of an instructional design proposal for Physics 1 (Mechanics) for two Engineering (Electrical and Civil). The course is a strategic concatenation of elements of other teaching methods in order to enhance the development of competencies. We promote a sequence of interconnected stages, called Cycles, that articulate elements of the Inverse Classroom and Hands on Activities. At the same time we challenge the student with an activity of greater complexity, a integrative project where the student constructs and compares a physical with a mathematical-computational model. In 2018 the course was refined and applied in four classes: three Engineering (Civil, Electrical and Biomedical) and a Technical Education in Buildings. Also worthy of mention is the institutionalization of a research group for the LIDF's own lines. The Laboratory clearly is going forward in its mission of creating didactic-pedagogical innovation in the teaching-learning for basic sciences for the Engineering.

Keywords: Active Learning Methodologies, Investigative and Demonstration Practices, Lab Proposal, Physics Teaching for Enginnering, Theory and Practice Integration.

26.1 Background

This article describes the progress in the clarification about didactic and pedagogical principles that establish the bases for the Laboratory of Didactic Innovation in Physics (LIDF - acronym in Portuguese), as well as elucidates questions about its attributes and branch of research [1].

26.2 Purpose/Hypothesis

The group of researchers and students connected to the LIDF deal with the following research branch: Development, adaptation and validation of educational products for physics teaching. It encompasses the development of experimental activities for various approaches and levels of complexity. It also includes development and adaptation of didactic sequences, including evaluation practices, as well as appropriation, application and discussion of results in the investigation of active learning methodologies.

An important action field is the support for projects in a similar way to FabLearn Labs, proposed by Paulo Blikstein at Stanford University, which are places that provide diversified tools for the students which can design technological apparatus from the use of these elements. The LIDF works not only to produce instructional resources, but also to contribute to the formation of an educational paradigm aimed at the development of competences by means of educational proposals that unite theory and practice in an indivisible way. In this sense, the laboratory team works with different formats of educational events both for the internal public and for the community outside the LIDF, acting as both initial and continuing training such as workshops; minicourses.

26.3 Results

There is a significant number of points to be highlighted as advances of the LIDF's proposal. First of all, we emphasize the increase in the physical area (from 60 meters to 150 meters) in a manner that turns possible to merge theory and practise at the same time and place, indistinctly, and in a easy way.

Besides, the lab had success in the acquisition of structured experiment kits and of the other tools as 3d printer. Furthermore, we have progress with the setting up physics experiments with low cost materials. The lab also had significant grow in its team and, because of this, we are running the Physics 1 discipline (Mechanics) for four courses simultaneously in according to the LIDF principles (in 2017 there were two courses running simultaneously). Nowadays we have a team composed by 4 Phd teachers, 2 master's students, 4 monitors and 10 students (fellows or volunteers).

We also increased our ability to support experimental projects, related or not to the proposal of the Physics 1 discipline. This support also includes short courses (as for example Excel, Ftool and Arduino as requisite for the student's projects) offered by our fellows and volunteers to undergraduate students enrolled in the Physics 1 disciplines. It is important to point, that in comparison to 2017, there is a substantive expansion and refining in quantity and quality of instructional resources (assessment activities (rubrics); research on active methodologies; Hands on activities; reading tests, projects, didactic experiments of several modes and levels of complexity, etc.). Also worthy of mention is the institutionalization of a research group for the LIDF's own lines and the acceptance for the legal institutional process of the proposal for a creation of coordination for didactic innovation in the Institute of Technology of UFPA.

26.4 Conclusions

The By all these indicators it is adequate to affirm that the LIDF proposal is clearly going forward in its mission of creating didactic-pedagogical innovation in the teaching-learning of Physics for the Engineering.

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CHAPTER 27

The Engineer Teacher and The Art of Teaching: The Challenge of The Teacher Engineer in Academic Training Good Professionals and Teachers

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Abstract: The Engineering courses in Brazil are increasing substantially over the years, in 1973 they were only 100 Engineering courses and in 2018 there are already 5924 courses registered in the Ministry of Education. This increasing collaborates with the economic growth of Brazil and confirms the increased demand for Engineers, masters and doctors, in the teaching career, to act in order to match the expectations of the country, working in the structuring of projects of courses and classes, for academic training of future Engineers is of utmost importance to the country, since they will be the human resources offered to the job market, hence the concern of the institutions should be what competencies they should have to meet the country's needs. The consequence of this concern in responding to these expectations of the society by a differentiated formation, made that the discussion about the education in Engineering had an emphasis in the didactic-pedagogical formation of the professor Engineer, demonstrating the proposition that differentiated activities in the classroom can interest in the

study at the beginning of the course, and facilitate learning. There are several recent studies that address new teaching situations using available technologies, which can be used to support instruction while motivating and engaging students. The study of several bibliographies indicates three competences necessary to the professor Engineer, the technical and scientific competence, the didactic-pedagogical competence and the knowledge of the social context that the course, the students and the job offers are inserted. This paper proposes, through a bibliographical review, the discussion of these competences, analyzing researches with professors who expressed their wishes in relation to each competency, as well as verifying suggestions from authors/researchers working with new teaching methods such as PBL (Problem Based Learning), and that incorporate the Multiple Intelligence Theory into teaching strategies as a way of assisting the learning process and the development of personal and technical characteristics necessary for the professional in formation. It is concluded that the competencies to make teaching effective and to work with the different types of methodologies, such as the active one, are basically identical, that is, the technical competence, the willingness to learn continuously as the students learn (didactic pedagogical competence) , the way of communicating the results obtained and the search for the knowledge of the context of the insertion of the academic community in order to enhance the desired results. Professors who believe in efficacy and are willing to advance in the work with active methodology will converge to an educational academic training action specifically aimed at the implementation of active methodologies. However, the ongoing process of sharing knowledge requires readiness and research in Engineering education.

Keywords: Academic Training, Higher Education, Multiple Intelligence Theory, Problem Based Learning, Professor Engineer.

27.1 Background

Brazil is a country known for having agriculture as one of the main economic activities, but there are other areas in the country, such as industry and science and technology, that require trained professionals through higher education courses, making the demand for training courses in the most diverse areas, mainly in the area of Engineering, increase proportionally to the country's growth [1]. This increase confirms the increasing need for Engineers in the teaching career, masters and doctors, as required by the Law of Guidelines and Bases (LDB) [2].

The consequence of this growing supply of Engineering courses and the demand of society for a differentiated formation made the discussion about Engineering education an emphasis on the didactic-pedagogical training of the professor Engineer. These discussions demonstrate the proposition that differentiated activities in the classroom can arouse the student's interest in the study at the beginning of the course, besides facilitating learning. There are already several studies that address new teaching situations using available technologies, which can be used to support instruction while motivating and engaging students in content.

27.2 Purpose/Hypothesis

The study of[2] states that it is a consensus among the professors surveyed that there are three essential competences to the professors Engineers: technical and scientific, didactic-pedagogical and knowledge of the context (being aware of who is teaching, in what context social and political is inserted the course, students and job offers). It is unanimous that the greatest deficiency of teachers is in the didactic-pedagogical skills and the knowledge of the context, with this the proposal of the work is to propose the reflection on the strictly technical formation of the Engineer in contrast to the growing need of professors and propose the preparation of the professor Engineer to work with the Multiple Intelligences Theory (TIM), a possible tool to be applied in the teaching process as an efficient alternative in the development of interpersonal skills, minimizing the differences and demands of the Market [3], and Problem Based

Learning (PBL), an educational method that makes use of everyday problems to stimulate the development of critical thinking, problem solving skills and learning the concepts that make up the programmatic content [4].

27.3 Design/Method

The most used strategies in teaching Engineering are the lectures, seminars and project developments. According to [5], these strategies, when well worked, enable the development of skills that are essential today in the insertion of the graduate in the market. The individual characteristics of each student are used in TIM to indicate ways to develop certain personal characteristics, so "to have it as an active variable during the activity of using strategies (seminar, lecture, project) is a way of guaranteeing success of the development of personal characteristics" [3].

PBL is a method in which students are challenged by problems early in their learning, motivating, focusing, directing and initiating their learning [6]. The teacher, in this cycle, acts as a facilitator, presenting the scenario of the problem to the students and thus they formulate and analyze it in the search for important facts that represent the problem, from there they understand it better and create hypotheses about possible solutions. The cycle is finished with reflection, students develop skills needed to solve the problem, autonomous learning, collaboration and lifelong learning [4].

27.4 Results

The strategies that today stand out and complement each other in Higher Education, especially in the area of Engineering, are the Multiple Intelligences Theory (TIM) and PBL (Problem Based Learning), which make the most of the characteristics of the students to develop them and makes them excellent professionals, including in the area of teaching, but it is necessary for teachers to recycle and encourage the training of future professors through disciplines in the didactic-pedagogical area, to make the correct use and make the most of these strategies.

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CHAPTER 28

Adapted and Automated Bathroom for Seniors and Wheelchair Users

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Abstract: At a time when the Internet of Things (IoT) market, home automation and domotics are no longer luxury goods, and with more affordable prices, they become a reality in people's lives. In this context, automation technologies are coupled with assistive technologies (technologies that provide accessibility, integration and independence for people with special needs), and give rise to a new branch of technology called Assistive Automation. The project in question deals with the adaptation of a bathroom in a residence, which can also be adapted for public buildings, as long as they comply with the standards of NBR 9050, which deals with Brazilian standards of accessibility. This building uses assistive technologies, which allow a better quality of life for people with motor needs such as: seniors and wheelchair users, facilitating everyday tasks such as turning lights on and off, or opening doors (motor drive, moving the door, for means of sensors) that, for non-carriers, seem rather simple, but for the target audience of this project represents a great discomfort. In addition to the comfort functions, the project aims to provide users with security by means of buttons and timers that monitor the user's status and, in case of emergency, sound alarms and unlock doors for immediate assistance. This work uses Arduino microcontroller, sensors and actuators that have a low cost of acquisition when compared to equivalent projects using PLCs (Programmable Logic Controllers) or Residential Automation Centers. In addition to its assistive functions, this project intends to disseminate the idea of assistive

automation in order to arouse the interest of new studies in this area, which has not yet been researched, which could in the future make it cheaper and make this technology popular and accessible to people of lower purchasing power. The project was developed in prototype and is undergoing refinement to be installed in APAE (Association of Parents and Friends of Exceptional) of Sobral-CE.

Keywords: Accessibility, Computer Engineering, Embedded Systems, Home Automation, Microcontrollers.

28.1 Background

With technological evolution increasingly efficient, home automation begins to gain space in a more popular market. The first uses of home automation systems date back to the late 1970s in the United States with some "smart" modules, whose commands were sent by the home's own electrical grid. They were simple, practical solutions that solved specific situations like remotely turning on/off some equipment [1].

Nowadays, with the advent of personal computing, mobile telephony, the internet and other technologies, the concept of "smart home" is becoming present in several projects. Some of these projects involve the concept of

Assistive Technology, which is a branch of technology aimed at people with special needs, with the aim of providing or expanding their functional abilities and, consequently, promoting independent living and inclusion [2].

The popularization of low-cost microcontrollers, such as Arduino, allowed cost savings in assistive automation projects. The low-cost microcontrollers are already used in several projects such as: 3D printers, home automation and even industrial automation. Although they have a low cost, they have an excellent processing capacity.

Although they are not a solution to all the needs of the elderly or those with special needs, new technologies can favor permanence and independence, safely, in their own homes, without needing to reside in institutions that take care of this public. These institutions, at best, have, even if few, some flaws and the closer to the ideal, the less financially accessible [3].

28.2 Purpose/Hypothesis

The purpose of this project is to make a room accessible to a dwelling, this being a bathroom using two Arduinos that control sensors and motor for opening doors, presence sensors, panic buttons and lighting, in order to provide greater independence of carriers special needs, especially those who live alone or have no company most of the time. More than providing a better quality of life, this project aims to reduce production costs.

28.3 Design/Method

The platform used in the project was the Arduino, which is a prototyping board composed of a microprocessor, a crystal or oscillator (a simple clock that has the function of sending pulses of time at a specified frequency, allowing its operation at the correct speed), a 5-volt voltage regulator, digital input and output pinout and analog data input [4]. For the programming of the board, its own IDE (Integrated Development Enviroment) is used, that uses the languages C/C++ adapted to the board [4].

The bathroom automation system has a loop arrangement with a certain degree of complexity, so we divide in events, the actions of Arrival and Exit, E1 and E2 respectively, so when a person arrives and uses the sensor, the door opens and waits 10 seconds for someone, until close again, actions A1 and A2 respectively. After the door closes, the presence sensor checks for 30 seconds whether there is anyone inside the bathroom and then we go to the first “if”.

If there is someone, a counter of 10 minutes is started. This counter is only to check the health of the user, because if there is any sudden illness and there is no way to ask for help, at the end of the time, an alarm will sound during 10 seconds and the door will open (A1) until someone comes in, rescue the user and press the reset button (B1) to stop the alarm (A4), and return the system to its beginning. If the alarm sounds and the user is in good condition, simply push the reset button (B1) and the counter will return to the initial 10 minutes.

Finally, if the user decides to exit (E2), before 10 minutes have run out, he sets the internal sensor (A1), exits and when the door is closed (A2), it is checked again if there is anyone inside the bathroom, if there is no one, the lights go out and the system is in the start state waiting for a new user.

The panic button (B2) has the function of calling for help, in case the user feels bad, but there are conditions to ask for help, just press B2 and enter into action A3 and A1, at that moment an alarm sounds and the door opens to be made the rescue of the victim. At the moment the victim is rescued, simply press the reset button (B1) and set the internal sensor to count for 10 seconds, closes the door and return the system to its initial state and wait for a new user. To ensure that no one enters, if there is a user in normal conditions in the bathroom's internal dependence, when detecting someone's presence internally, the system switches off the external sensor, which is only turned on if the system returns to its start or occurs A3.

There are two cases where running runs out of common flow of the system. The first case is when someone gets in the way of the door for more than 10 seconds, a pair consisting of transmitter and receiver of infrared signals are activated the moment the door begins the closing process in case something prevents reception of the signal emitted, the system understands that there is an obstacle in the way and opens the door again, another 10 seconds are counted and the process repeats itself until there are no obstacles in the way. The second case is similar to the first, but if the infrared sensor detects no obstacles, but the door for some reason stalls, the current sensor will detect a peak current above the set point and the port will instantly return to the current position. While the problem is solved, the system waits for new opening or closing of the door.

28.4 Results

The project in question was assembled in prototype format and obtained the expected operation. As results, we compared the costs involved in the project and the costs of an automation central performing similar functions.

Taking the sum of the total amounts, we reached the amount of R$ 504.0 (Five hundred and four reais). If we compare to the Fibaro Home Lite Home Automation Center, which has similar functions for communicating with mobile devices, having the average cost of R$ 2,000 (Two thousand reais), we have reached a lower value of R$ 1,496. Which represents a savings of 74.8% in relation to the Automation Center, which would lead to more expenses by adding the necessary components such as relays and Z-Wave sensors.

28.5 Conclusions

As previously discussed, the low-cost assistive home automation project aims to provide quality of life for people with physical and motor needs. There are already some similar projects using Automation Centers or PLC's, which make them expensive and not very accessible, since only a small portion of these users have purchasing power for such acquisition.

Low-cost microcontrollers, such as Arduino, are a major revolution in the automation market. This is due to its costs and efficiency that make projects, previously seen with a certain disbelief due to the high costs, completely executable.

The idea of assistive automation is still less widespread. Companies allocate little investment to this area in relation to existing demand, making products more expensive and less accessible.

After demonstrating that this project is feasible and accessible, it is hoped to sharpen the willingness of developers to invest knowledge in this area, so that new ideas and projects emerge, aiming not only at the financial side but at forming a social conscience.

The project was organized into boxes suitable for electrical systems, so that it was best exposed aesthetically and tested in the premises of the APFE (Association of Parents and Friends of the Exceptional) of Sobral - CE - Brazil.

In future, the printed circuit of the system will be made to be donated to the institution.

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CHAPTER 29

Use of Flipped Classroom Elements: A Case Study in Teaching Physics for Engineering at The Federal University of Pará

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Abstract: The Laboratory of Didactic Innovation in Physics-LIDF proposes for the discipline of Theoretical Physics I offered in the Civil Engineering course of the Federal University of Pará the implementation of a Didactic Sequence based on the methodology "Flipped Classroom". Our purpose in proposing

SD actions based on the inversion of the traditional teaching model was to provide less expositive classes that are capable of engaging students in content, increasing participation, student-teacher interaction, and improving the use of time. The teaching method described here suggests “doing” in the classroom, enabling the student to cope with situations similar to situations in the professional life of the civil Engineer, demanding that the student: intervene and question the problem; analyze the situation; select in your mind a scheme of action and together with other learners act in a flexible and strategic. However, in order to achieve this there is a need for the student to study before class. For this purpose we have developed what we call Reading Tests-RT’s, where the student receives the instructional material containing, among others, videos, links to digital resources and text and/or image files. In addition, you receive an online response form that meets the following functions: (a) Encourage and evaluate the study of the material using essay questions that investigate the “reading” of the content; (b) Provide a less superficial study proposing an issue that requires application of some knowledge contained in the material; (c) To provoke a reflexive posture proposing an unstructured question allowing the student to make inferences and estimates in order to answer the question; and (d) To provoke the link between the instructional material and the face-to-face meeting with a multiple-choice question whose discussion can begin the work in the classroom. As a way of analyzing whether the RT’s complied their objective, an opinion questionnaire with discursive and multiple choice questions was applied, which was answered in an online platform at the end of the course and had membership of just over 35% of the class. In general, there was a significant recognition of the importance of the proposed method as it helped to assimilate the contents and made the students able to question and inquire the teacher in the classroom. It was also proven that RT's encouraged students to determine a regular study schedule for the proposed activities in the discipline. It is also worth mentioning the participation of the students. Of the total of 42 enrolled, 25 maintained its frequency equal to or greater than 75%. This number increases when we speak of students who had a frequency of 50% or more, totaling just over 34 students (81%). This fact is relevant since in the courses of Engineering the evasion of the students is a recurrent phenomenon. As a consequence of these data and others still under analysis this method of teaching continues to be applied in the discipline of Fundamental Physics I offered in the Civil Engineering course and also now for the Electrical Engineering course of the same University.

Keywords: Physics Teaching, Flipped Classroom, Reading Tests.

29.1 Background

Many teachers are increasingly aware of the challenges related to the truly contemporary Engineering teaching and then realize that it is no longer possible to address them by adopting only the so-called traditional teaching techniques in which knowledge is emanated exclusively by the teacher [1]. The intention to propose methodologies based on the inversion of the traditional model of teaching aims to promote less expositive classes that are capable of engaging students in participatory learning processes that stimulate the interactions among students and professors. In principle, this kind of change is capable of promote varied benefits, such as: the development of communication skills; teamwork and collaboration of ideas; better use of class time, among others. With this aim, we present the following steps of a didactic intervention that makes use of inverted classroom elements.

29.2 Purpose/Hypothesis

The flipped classroom is one of the so-called active learning methodologies and, therefore, has focus on the student. As its name suggests, this teaching methodology reverses the classroom organization logic [2]. Previously, the student has access to the class itself in his home or in other place, and the time in the classroom is used to address to deeper questions and understandings about the subject. So, it is expected that the student tends to have a more qualified participation during the classroom itself. By other hand, the teacher becomes not only an exhibitor, but also a tutor who assists and encourages a more in-depth learning on the part of the student.

Such methodology is really different from the traditional one, and because of that the students need to be prepared and oriented to reach all its potential [3].

29.3 Design/Method

We produced Reading Tests (RT) in the form of online questionnaire to be answered by the students, before the occurrence of the class. These RT include the instructional material for the student, containing videos, links to digital resources and text and/or image files as auxiliary additional resources. The RT meet the following functions: (a) Encourage and evaluate the study of the material using essay questions that investigate the "reading" of the content; (b) Provide a less superficial study proposing an issue that requires application of some knowledge contained in the material; (c) To provoke a reflexive posture proposing an unstructured question allowing the student to make inferences and estimates in order to answer the question; and (d) To provoke the link between the instructional material and the face-to-face meeting with a multiple-choice question whose discussion can begin the work in the classroom.

The Figure 29.1 presents a summary schema of the proposal that also intends to promote an approximation between theory and practice in the teaching of physics as from the confrontation of situations-problems that bring analogies with situations experienced in the professional life of the Engineer. Such situations-problems are termed as hands on activities.

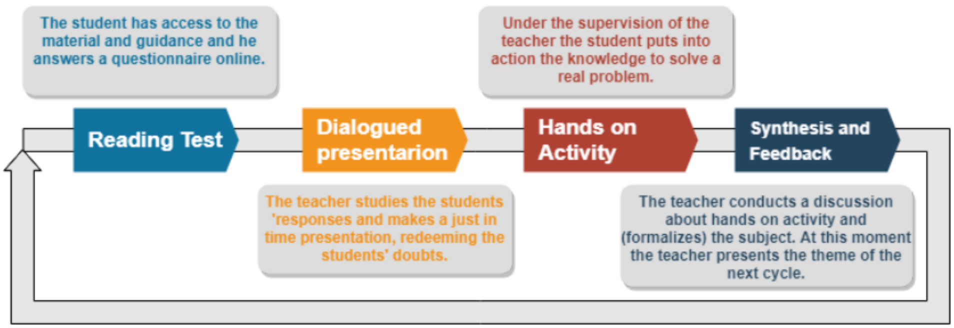

Figure 29.1 – Didactical cycle for development of competencies.

29.4 Results

As a way of analyzing whether the RT's complied their objective, an opinion questionnaire with discursive and multiple choice questions was applied and answered in an online platform at the end of the course and had membership of just over 35% of the class. In general, there was a significant recognition of the importance of the proposed method as it helped to assimilate the contents and made the students able to question and inquire the teacher in the classroom. It was also proven that RT's encouraged students to determine a regular study schedule for the proposed activities in the discipline. It is also worth mentioning the participation of the students. Of the total of 42 enrolled, 25 maintained its frequency equal to or greater than 75%. This number increases when we speak of students who had a frequency of 50% or more, totaling just over 34 students (81%). This fact is relevant since in the courses of Engineering the evasion of the students is a recurrent phenomenon. As a consequence of these data and others that still under analysis, this method of teaching continues to be applied in the discipline of Fundamental Physics I offered in the Civil Engineering course and also now for the Electrical Engineering course of the same University.

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CHAPTER 30

Evaluation of Academic Experience in Learning Education over Simulator Softwares

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Abstract: In recent years, the use of technological resources has been changing the way which practical teaching is carried out in undergraduate and technical education. In Brazil, this approach is further studied because of the number of technical and Engineering courses that are offered in the distance format. In several cases where the student only has access to a theoretical information, making this connection between theory and practice becomes even more challenging. In this case the student have any access to laboratories and equipments for conducting experiments. Electrical, electronic or computer courses use laboratories in order to test the theories and practices, being great importance and aid the use of simulators that allow the student to carry out practical experiments. The contribution of this work is presenting the results obtained from the application of computational simulators in classes of digital electronic circuits and computer networks over two different courses. The students were challenged to perform experiments on computer simulators using desktop, web or mobile applications, and then compare the results from the practical experiments. The realization of simulations allowed students to start initial tests on the use of different equipments and circuits. At the end, them were asked to answer a questionnaire (Quiz) regarding their perception of the use of simulators before and after practical experiments. Most students reported that the use of simulators allowed relating theory to practice. From the collected results it was possible to identify a positive on the use of simulators during the learning of electronic digital circuits and computer networks. These simulators not only improved the academic performance of students but also allowed them to initially relate theory to practice with more confidence and security, considering that for most students this has been the first contact with electronic equipments and circuits.

Keywords: Engineering Education, Environments Teaching, Simulation Learning, Theoretical, Practice Learning.

30.1 Background

In last years the modes of education has been presented to students several changes for many reasons and aspects. This condition allowed improvements in the way of education methodologies get in the live of students, specially about the modalities of presence or distance education. Technologies present challenges in education Universities and institutes specially about distance courses. In each institution, the students are formed and instructed about specifics subjects and areas of knowing. In the other part, pedagogic models of learning and education try to shape the students in traditional and obsoletes methodologies learning, that in several of time not allow the free thinking and interpersonal developments of students in the schools [1]. This scenario generate a demand about models of learning in different modalities of Universities, in special the presence education.

Virtual learning environments (VLE) is a social and learning space for educational iterations where the students are not only active, but also the actor that help to improve and co-construct the space. These VLEs are not restricted to distance education but can be used for students in presence classroom activities [2]. In this paper, we proposed the application of simulators in students activities in order to analyze the perception from student before and after lessons.

30.2 Purpose/Hypothesis

Simulators has been used in several projects of learning and teaching education, and present a new paradigm of world education. Nikolic (2009) presents an overview about the simulators suitable for teaching courses in computer architecture and organization. The author presents a main challenge work with this subjective is prepare the student for real situation when has to develop a computer architecture [3]. In order to training students in computer networks, Janitor, Jakab and Kniewald (2010) present the main contributions and statistical from the use of Cisco Packet Trace in classrooms [4]. The Cisco Packet Trace is one of the traditional student simulator for computer networks and is used in this paper. Balamuralithara and Woods (2009) described a Virtual Laboratories in Engineering education to electronic digital activities. Results show that virtual environments improve and stimulate the students for intensity studding in free times [5]. The Proteus simulator is used for teaching microcontroller for students of Engineering. Proteus VSM is uniquely suited to teaching students about design and operation of microcontroller based systems [6].

30.3 Design/Method

In this design we applied the used of simulators in three different class. The first is a Logic Circuits in Electrical Engineering, the second class is a Computer

Networks in Bachelor System Information, and finish class is a Digital Circuits in Electronic Technical course. The process of experiments from Jan. 2018 to May. 2018 is presented in Figure 30.1.

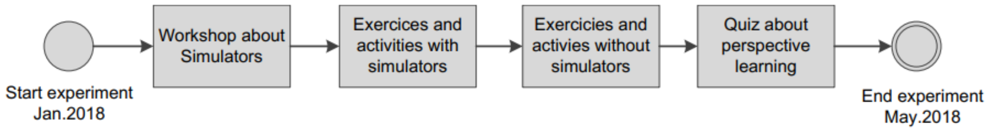

Figure 30.1 – Methodology sequence.

In the first activities the students participated in workshops when was demonstrated many simulators. The Computer networks class had an overview about Cisco Packet Trace and Logic Circuits worked with Falstad, Everycircuit, Logic Simulator, Logisim, EasySim, Part SIm, Proteus and Multisim. The second part, the both class had to accomplish simple activities with a tutor orientation using simulators. After the simulation, each class had to do the same activities with real equipments and machines. The main objective was compare the results of simulation with the practice experiment.

The last stage of methodology sequence was to applied a Quiz to students. The questions affirmatives are presented as follow, where the student could match in five levels alternatives (1 - totally disagree, 2 - partially disagree, 3 - not agree and not disagree, 4 - partially agree, and 5 - totally agree). The affirmatives are: Q1. The use of simulators aroused the interest of student in the content studied. Q2. The use of simulators facilitates the learning of new contents and concepts. Q3. The use of simulators facilitates the accomplishment of the practical activities and of studying the contents. Q4. The use of the simulator allows the expansion of knowledge beyond theoretical content. Q5. The use of simulator has extended its technical knowledge in the field. Q6. The use of the simulator allowed the conceptual and procedural understanding of the simulated activity. Q7. The use of the simulator allowed the argumentation from the simulated results. Q8. The use of the simulator allowed to identify the difficulties that can arise in a circuit and network implementation. Q9. Experimental practice has extended its technical knowledge in the field of logic circuits and network. Q10. The use of the simulator is dispensable for performing the experimental practice. Q11. Experimental practice is dispensable when using simulator. Q12. From the simulators currently available, it is possible to state that the practice of digital circuits and computer networks may be entirely non-presence. After the application of Quiz, the results was quantified and presented in the next section.

30.4 Results

Figure 30.2 shows the results of the Quiz answers of students. As possible to confirm in affirmatives one to nine, the students understood simulators create new initiatives and perspectives about technical themes. Simulators improve the acknowledgment of most of students interview in Quiz about understanding conceptual preceding. In affirmative ten the most of student think that simulator may not influence if is available technical laboratories with full equipments, components and resources. Same students think that practical experiments and activities have to made parallel with simulator, where this affirmative is confirmed when verified in question eleven. In the last affirmative, the students were asked about existence simulator can replace totally presence classes in Universities or institution educations. For the most students, even knowing this contribution of simulator in education, not yet possible replace traditional learning when student has to watch class in rooms.

30.5 Conclusions

Results show that students accept positively the use of simulator in presence classes in undergraduate institutes. For future and extension of this paper we have informations about the last 10 years with about 700 students score, in order to analyses the relation in using of simulator and the scores performances of each one.

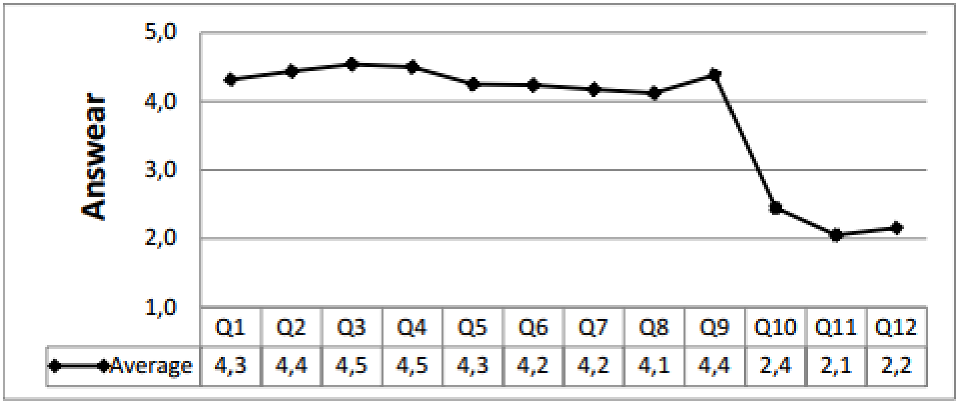

Figure 30.2 – Average answers of Quiz.

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CHAPTER 31

Improvements and Advantages of Using Moodle to Support Out Classes Case Study in Engineering and Technical Courses

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Abstract: Technology resources have become an important tool to support teaching learning within educational environments. These resources allows not only the recording and monitoring of the performance of students history, but also has been used as a tool to support the out classroom. In presence courses, students have accompaniment of teachers and tutors to the academic and knowledge information within a content or specific area of studies. However, the autonomy outside classroom not only allow the student in order to show independent cognitive abilities, but also allows teachers to follow the interaction and learning of the student. Among technological resources widely used by the institutions, we may mention the Moodle. Moodle is an open source educational support tool used in distance learning and academic training courses. Moodle allows students to access content available, create and participate discussion forums, perform activities and exercises, submit proposed and mandatory homeworks, send messages to teachers and colleagues, perform exercises or tests with real-time resolution, consult feedback of activities, among other activities. The access of these resources allows students and teachers to manage academic activities further enhancing the academic achievement and achievement of presence lessons. This article presents the behavior and interaction about 70 students in two different disciplines of an undergraduate course. The profile of each student was analyzed in relation to the number of accesses to the Moodle platform. Results show that the grading score is directly related to how the student interacts in Moodle. It is concluded that technological tools such as Moodle, when used as a resource to support the classroom, helps in teaching learning by stimulating students in accessing information and thus improving their academic performance.

Keywords: E-learning, Distance and Flexible Education, Moodle, Learning Management Systems, Tool Education.

31.1 Background

Education and especially how teaching policies influence the way they study learning has changed significantly in recent years. These changes are the result of years of research into tools and techniques that allowed students to improve how theoretical and practical knowledge could be cognitively absorbed.

Therefore, the technology has been a great support to students in presence education [1]. Among the main tools available today for help in teaching learning outside the classroom is Moodle. Moodle is a platform that allows teachers and students to interact and access a range of materials such as theoretical content, forums, activities and communication portals.

In relation to the courses in the area of exact, and more precisely in the Engineering courses, it is known of the assured productivity in the process of teaching and learning when one observes an interaction between technologies and computational tools, be it in laboratory practices, or in software simulations appropriate [2]. In this paper we present the analyses of students in an undergraduate course with integration Moodle.

31.2 Purpose/Hypothesis

In Romero et. al. (2013) is showed how the Moodle working with data mining techniques can be used for e-learning systems in order to predict the final exams scores of students in a University. Results presented the estimation of students score using 21 techniques, where about 65 % shows that it is a very difficult task to predict the students' final scores [3].

Conjin et. al. (2017) realized the measurement of student performance from Learning Management System. In order to predict the performance was used a historic of interaction of student from 17 different curses. Results show how much interaction with Moodle, higher is the performance of class from courses [4].

Moodle Quizzes are used by Blanco and Ginovart (2012) in order to contribute to the formative e-Assessment of first-year Engineering students in mathematics courses. The analysis of the psychometric coefficients provided by Moodle proved to be a useful tool for assessing whether the questions had an appropriate level of difficulty and were suitable for discriminating between good and bad performers [5]. Chen et. al. (2012) also present an analysis of Moodle in Engineering education from the use Technology Acceptance Model. A total of 260 Computer science students from six classes was asked about positive attitudes and system quality of learning motivation [6].

31.3 Design/Method

The methodology presented is based on the collection and analysis of access logs in the Moodle environment of two undergraduate discipline of the electrical Engineering course at a Brazilian University. These two classes are 100 % presence and have no distance content. The two classes are related to the disciplines of Logic Circuits and Reliability of Electronic Circuits. The analysis of the results will be showed in three stages. First, the number of accesses made by the students is verified. Second, the relationship of the type of content accessed by students is verified. And finally, the relation of the notes and the percentage of accesses. The results will be shown in a table.

31.4 Results

So, the Table 31.4 show the main results collected. The first class had a total of 26 students with an average of 281.6 clicks per student, and the second class with 43 students and an average of 154.3 clicks per student. It is possible to see that the number of students and the clicks in the Moodle is not proportional to number of clicks average. Each class may represent different scenarios, cause the professor can use different ways and methodology teaching. The table shows the percentage of use for each type of content in courses. In course of Reliability there are more content access cause the amount of pdf files is higher than Logic Circuits course. Tasks represent more than 50 % of access in Logic Circuits due about twelve mandatory activities. The Table shows the relationship between the amount of access in percentage and the final grades obtained by the students. It is possible to identify that in both discipline the students with lower index of notes have a minor interaction in Moodle. In both cases students with B scores have a higher percentage of access, followed by students with C and D scores.

Table 1. Information percentage about type of content in Moodle and access performance.

Course name	Logic Circuits	Reability in Eletronic System
Content	17%	47%
File send	5%	2%
Forum View and Answer	8%	26%
User reports	2%	3%
Task	68%	22%
Total	100%	100%
Score A	14%	22%
Score B	41%	60%
Score C	18%	15%
Score D	16%	2%
Score E	11%	1%
Total	100%	100%

31.5 Conclusions

Results show that performance students in two electrical Engineering disciplines is related to the number and number of accesses in the Moodle content and activity access environment. As future work is estimated the analysis and verification of the performance of students of 13 classes of undergraduate and technical courses with approximately 420 students of the last 4 years.

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CHAPTER 32

The Impact of Knowledge Management on The Quality of Learning in A Higher Education Institution

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Abstract: It is important to know the perceptions of the students, since the

attributes that make up the satisfaction of the service are subjective and diversified, because when the higher school knows what the student thinks important then there is the opportunity to reorient the service offering, seeking to meet with quality the customers and thus create competitive advantages. In view of this context, the following question is asked as a research question: What are the expectations and perceptions of students about the quality of teaching? The present research project had the purpose to identify the critical factors for the improvement of quality teaching in a higher education institute by using of an organizational excellence tool the knowledge management. This research was carried out on the campus of the Salesian University Center of Sao Paulo, locates in Lorena, more specifically in the 1st and 5th year of the industrial Engineering course. The empirical study on a Knowledge Management was done seeking its performance as a tool of organizational excellence. The completed project allowed us to understand how the interaction between market, society, students and institution is realized so that all ideas converge in the ideology of solving problems of society and satisfy the needs of the students, always seeking a teaching of quality. The criteria used for the development of this research were found in the bibliographic review, the ideas of their respective references converged partially in the same sense and objective of this research. The PPP (Educational Policy Project), PE (Teaching Plan) and pre-determined criteria were analyzed in which, through content analysis, it was possible to identify possible gaps and thus possible opportunities for improvement without teaching quality. Two research questionnaires were elaborated in 2017, which were evaluated by the University Center's ethics committee, validated and later applied in the already referenced classes, whose objective was to understand the expectations of the students' incomes and perceptions regarding the quality of teaching of the course. The analysis of the results collected, from the forms and the PPP and PE documents made it possible to verify if the criteria found in the literature really corresponded to the realities of the University Center under study and to identify among them the critical factors for improvement in the quality of teaching.

Keywords: Class Plan, Industrial Engineering, Knowledge Management, Political Project Pedagogical, Teaching Plan.

32.1 Background

It is important to know the perceptions of the students, since the attributes that make up the satisfaction of the service are subjective and diversified, because when the higher school knows what the student thinks important then there is the opportunity to reorient the service offering, seeking to meet with quality the customers and thus create competitive advantages. In view of this context, the following question is asked as a research question: What are the expectations and perceptions of students about the quality of teaching? The present research project had the purpose to identify the critical factors for the improvement of quality teaching in a higher education institute by using of an organizational excellence tool the knowledge management [1-8].

32.2 Hypothesis

This research was carried out on the campus of the Salesian University Center of Sao Paulo, locates in Lorena, more specifically in the 1st (T1) and 5th year (T2) of the industrial Engineering course. The empirical study on a Knowledge Management was done seeking its performance as a tool of organizational excellence. The completed project allowed us to understand how the interaction between market, society, students and institution is realized so that all ideas converge in the ideology of solving problems of society and satisfy the needs of the students, always seeking a teaching of quality.

32.3 Method

The criteria used for the development of this research were found in the bibliographic review, the ideas of their respective references converged partially in the same sense and objective of this research. The EPP (Educational Policy

Project), TP (Teaching Plan) and pre-determined criteria were analyzed in which, through content analysis, it was possible to identify possible gaps and thus possible opportunities for improvement without teaching quality. Two research questionnaires were elaborated in 2017, which were evaluated by the University Center's ethics committee, validated and later applied in the already referenced classes, whose objective was to understand the expectations of the students' incomes and perceptions regarding the quality of teaching of the course. The analysis of the results collected, from the forms and the EPP and TP documents made it possible to verify if the criteria found in the literature really corresponded to the realities of the University Center under study and to identify among them the critical factors for improvement in the quality of teaching. It was also possible to verify that the CPP and TP of the Production Engineering course of the HEI under study is approximately 91% according to the criteria analyzed and 9% with opportunities for improvement. Based on the above analyzes, it is possible to verify certain improvement opportunities that will be confronted with the results verification of the application of the research questionnaires applied in T1 and T2. The first questionnaire of the research presents the value of the Cronbach Alpha coefficient classified as "good", with the alpha value equal to 90%. The second survey questionnaire also presents the value of the Cronbach Alpha coefficient classified as "good", with the alpha value equal to 86.82%. As for the content analysis performed on the CPP and

TP, five criteria were identified that at some point were flawed, leaving gaps and possible opportunities for improvement to be studied.

32.4 Results

The following observations are to be evaluated by HEI: Criterion C1 - Impact on employability: The difference of 22% between teachers “expectations and the students” perceptions can be justified because this criterion was not observed in EPP and TP. Criterion C2 - This criterion was not observed in the analysis carried out on the TP, however the incoming students have considerable expectations for this criterion since the graduates did not have a good experience in the course of the course. Criterion C3 - The expectations of the first year students are higher than the perceptions of the future production Engineers and can be justify the difference of 17% between the results due to the lack of specific activities regarding this criterion for the future graduates. Criterion C4 - Interpersonal Relationship: This criterion defines how the students will develop with the other students during the course. The students' perceptions are higher in 13% of the expectations of the students. Criterion 5 - Researcher profile: The data collected for this parameter are approximately equal. Criterion 6 - Negotiator Profile: On this parameter, the results are equal. Criterion 7 - Communication: Expectations and perceptions for this parameter showed almost no disparity in results. Criterion 8 - Critical Sense: This criterion was found in the content analysis presented and there was improvement of the expectations for the perceptions. Criterion 9 - Critical Absorption: It is interesting to note that the student's expectation does not change almost from the previous criterion; however, the egress had a different pattern of responses for this parameter. Criterion 10 - Problem Solving: This parameter has the same percentage of answers in the questionnaires of the tickets and the graduates. However, this was not found in the TP analysis. Criterion C11 - Level of responses to market expectations: This parameter was not found in the PPP analysis and was found in the TP analysis since the course is introductory and presents to the teacher some tools that will be developed in the course and the possibilities of acting in the market.

32.5 Conclusion

Regarding the above criteria, the following study resolutions are highlighted, emphasizing that the improvement proposal if evaluated and accepted by the University Center should be introduced in the structure of the CPP and TP. With regard to the development of the research, it was possible to identify the gaps in the CPP and TP of the HEI, to map and graphically plot the students "expectations and the students" perceptions regarding the quality of teaching and to perform the analysis of the interaction between the gaps found and the results of the questionnaires. Finally, it is important for HEIs to use knowledge management in the quest for organizational excellence, since research has led to the understanding of the importance of using management tools to capture and retain knowledge for quality reasons whether they are in administrative services or teaching.

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CHAPTER 33

Critical Factors in The Participation of The Institutional Evaluation in A Higher Education Institution

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Abstract: With the growth of higher education in recent years, Universities are seeking improvements in the service offer, reaching a greater demand and more recognition by society. Through internal evaluation, it is possible to monitor quality teaching, as they analyze what students need, in order to interconnect what institutions have to do in order for both to succeed. The institutional evaluation is a constant process that helps the University to identify the positives and negatives to improve the quality of the same. However, the low participa-

tion of the students in the institutional evaluation hinders the University to create improvement actions. As a research question has: Why the low adherence of the students in the evaluation? How to increase the participation rate with qualified answers? The objective of this work is to present an analysis of the factors associated with low participation and quality of the institutional evaluation. The method applied was a case study at the Salesian University Center of São Paulo, where interviews were conducted with students of the Production Engineering course during the year 2017. The interview took place in two forms, a qualitative approach at first for identify the influential variables and, later on, a quantitative approach with the purpose of ordering them by importance and grouping them into common factors. The tabulated answers allowed to identify the influential variables in the low adherence of students in the institutional evaluation. After the identification, it adopted the techniques of ordering variables, together with statistical techniques in order to prioritize the variables found and group them into factors. The research pointed out new variables through the fieldwork that can contribute to improve the institutional evaluation. In addition to the validation of the influential variables in the studied process, the research pointed out that the communication of results is the major contributor to the low adherence, since it does not occur in a systematic and transparent way, thus leading to other variables such as demotivation of the students. Lack of management also contributes to flawed communication where research benefits are not evident leaving students without understanding the real reason for it. The work still points as a suggestion of future research, the understanding of what communication would be for students and institutions.

Keywords: Critical Factors, Factor Analysis, Higher Education, Institutional Evaluation, Ordering the Variables.

33.1 Background

With the growth of higher education in recent years, Universities are seeking improvements in the service offer, reaching a greater demand and more recognition by society. Through internal evaluation, it is possible to monitor quality teaching, as they analyze what students need, in order to interconnect what institutions have to do in order for both to succeed. The institutional evaluation is a constant process that helps the University to identify the positives and negatives to improve the quality of the same. In order to become more competitive, Universities seek new actions for improvement, and to assist them in the decision-making process, institutional evaluation is used, which includes internal and external evaluation, thus assuming an extremely important role. However, the low participation of the students in the institutional evaluation hinders the University to create improvement actions. As a research question has: Why the low adherence of the students in the evaluation? How to increase the participation rate with qualified answers? The objective of this work is to present an analysis of the factors associated with low participation and quality of the institutional evaluation [1-10].

33.2 Hypothesis

Implemented in the Universities by Law nº 10.861/2004, the Self Evaluation Committee (CPA) in an IES has the function of coordinating, planning and articulating the evaluation processes according to SINAES. The internal evaluation is coordinated by the CPA and contemplates the global and integrated analysis of the ten dimensions organized into five planned axes, namely: Axis 1 - Institutional Planning and Evaluation; Axis 2 - Institutional Development; Axis 3 - Academic Policies; Axis 4 - Management Policies; and Axis 5 - Physical Infrastructure. The research was developed at the University Center of São Paulo, São Joaquim Campus, besieged in Lorena/SP. For the accomplishment of the research the group of the 5th year of the course of Production Engineering was chosen, in order to have the lowest adhesion in the institutional evaluation.

33.3 Method

The reason for being the 5th year is due to the fact that they are students who have answered more than 8 evaluations and can explain the reason for the low adherence. The research was divided in two parts, being the first theoretical where a bibliographical research was carried out through publications of articles, being its majority based in the last 10 years, aiming to search in the theory the variables influents in the reason of the low adhesion of the students in carrying out the institutional evaluation. In the second part, a questionnaire was applied with the students of the 5th year of the Production Engineering course, in order to recognize other variables different from the bibliographic review, in a qualitative way. A second questionnaire was also carried out, where the most important variables were classified according to the qualitative result, and applied to all classes of the Production Engineering course, since its representation in the HEI is 23% of the Engineering courses, thus obtaining, a quantitative result. The interview was conducted with the students, through a face-to-face meeting and Survey Monkey program to facilitate the participation of all. In the first questionnaire, we obtained 88.75% of the answers, and with this, 7 variables were obtained that were relevant for low participation of the students in the institutional evaluation. In order to carry out the second questionnaire, the students of the Production Engineering course were selected, where the application happened in 8 different classes, in which it obtained a return of 47% of the answers. The tabulation of the data was given considering the 7 variables with 163 different orders.

33.4 Results

The tabulated answers allowed to identify the influential variables in the low adherence of students in the institutional evaluation. After the identification, it adopted the techniques of ordering variables, together with statistical techniques in order to prioritize the variables found and group them into factors. The research pointed out new variables through the fieldwork that can contribute to improve the institutional evaluation. In addition to the validation of the influential variables in the studied process, the research pointed out that the communication of results is the major contributor to the low adherence, since it does not occur in a systematic and transparent way, thus leading to other variables such as demotivation of the students.

Through the literature review, four variables were identified that show the low adherence in the institutional evaluation: they benefit from the institutional evaluation for University, communication, culture and management. With qualitative research it was possible to identify three new variables: demotivation, dissemination and extensive questionnaire, and had the confirmation of the four variables presented in the literature. After the qualitative analysis, the research had a quantitative focus on ordering the variables by importance, according to the input of the participants. With the tools it was possible to verify the ordering of the variables according to the degree of importance informed by the participants about the low adherence of the students in the institutional evaluation.

The work contributed to the identification of new variables on the low adherence in the institutional evaluation, as well as the order of importance. This ordering may help HEI to understand the problem and propose solutions for improvement. According to the ordinance, it was shown that no variables were very prominent, because they were very close to say what the cause is. As the delimitation of the research was for the students of the Production Engineering course of which there was little participation of the students, the variable of Communication of the Results was that one position was always ahead of the other variables.

As the variables were around the median of the stations, we can not have a conviction regarding the distinctive importance of the variables, so all variables are considered important. A correlation matrix was run where the variables are poorly correlated. The affinity of the variables found and pointed in the literature, allowed to highlight the variable of communication of the results as the main factor of low adhesion.

33.5 Conclusion

Lack of management also contributes to flawed communication where research benefits are not evident leaving students without understanding the real reason for it. The work still points as a suggestion of future research, the understanding of what communication would be for students and institutions.

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CHAPTER 34

Short Film: "A Troca"

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Abstract: The Festival Internacional de Cinema e Vídeo Ambiental (FICA) is a consolidated and prestigious film festival in Latin America that exhibits and awards the best productions of each year. Aiming to participate and obtain awards in the next edition of the festival, the "PET - Engenharias (Conexões de Saberes)" Group (PETEEECS) wrote a script and produced an environmental film that presents the problems related to non-ionizing radiation. The purpose of the production of the film "A Troca" ("The Barte" in English language) is to inform viewers the main harmful effects related to such radiations, present in radio sets, cell phones, microwave apparatus and others. In addition, it aims to make the public aware of new practices and habits that minimize the use of devices that emit such radiations. The film's producers also propose to dissem-

inate such information not only in the academic field, but also to the public of regional festivals, such as others national and international festivals. The film was produced with low budget and few actors where it was used technology of 4K filming besides the use of a drone to make aerial images. The main concern of the production was with the scenarios and the costumes used by the actors. All the scenes of the film were recorded in three intense days of filming, and although the objective of the film is to inform about non-ionizing radiations. In addition, the film is devoid of speech and the message is passed through the interpretation of the actors and a text that appears at the end of the last scene. The footage taken was edited and compiled, just as the soundtrack was selected and added to the film by the editing team, composed of a member of the PETEEECS and the Laboratório de Engenharia Multimeios (Engemulti). The goal of the film to be broadcast in 2019 at FICA will be fulfilled and the main message, informing about non-ionizing radiation, will be taken to various segments of the public, increasing knowledge about the dangers and effects that technological devices can bring and raising awareness the general public.

Keywords: Exchange, FICA, Environmental Film, Non-ionizing Radiation, PET.

34.1 Background

The PET - Engenharias (Conexões de Saberes) Group (PETEEECS) has a branch focused on the exchange of information and knowledge between the University, the community and society. Aiming to work in this format, the group decided to produce a film, "A Troca", where the problem of non-ionizing radiation is problematized [1]. In addition to divulging the problems arising from this type of radiation, the project aims to diversify the group formation in addition to the training in audio and image editing in partnership with the Laboratório de Multimeios (Engemulti) from Universidade Federal de Goiás.

34.2 Hypothesis

Following the motivation to raise awareness about non-ionizing radiations, the idea arose of producing a film totally without speech, in which the written script shows the story of a traveler, a peddler and a girl from the interior, who have their paths crossed and deal with the harmful effects of technology.

For the production of the film, the students who composed the cast were chosen from among the members of the PETEEECS, and three members were chosen for the main characters mentioned above. The choice of costumes was made with the intention of conceiving the characters in order to facilitate their identification they were characterized on the basis of ordinary stereotypes. As can be seen in Figure 34.1, the girl of the interior wears simple clothes, carries an old suitcase, typical of the interior (place of origin of the character), and the peddler with fussy garments and accessories.

Figure 34.1 – The peddler and the girl.

The chosen scenario sought to portray the problem, as well as to contemplate the local patrimony of the state of Goiás, through the historical city of Goiás shown in the Figure 34.2, and others locations such as: the antennas in the Morro do Mendanha; important tourist points of the city of Goiânia, as the Praça Cívica; a well-known open fair; among others.

Figure 34.2 – The traveler in the city of Goiás.

34.3 Method

In order to have the best image results [2], the scenes were recorded in 4K resolution and for area view a drone was used, which allowed the capture of very beautiful and detailed shots. The camera used in filming, has an interesting quirk, its lens in fish-eye format, which provides a 180º view.

During the entire recording process, only one camera was used, which was often changed position to shoot at all angles and perspectives needed.

As a result of this factor, extra care had to be taken, not to compromise the continuities of the scenes, due to climatic changes, schedules, and scenery change.

The Universidade Federal de Goiás (UFG), supported the students in the production of the film offering the Kombi that was used in the filming. In addition, professors Getulio Antero de Deus Júnior, Marcos Lemos Afonso and José Wilson Lima Nerys, actively assisted throughout the creation process, from development to final editions.

In the editing of the film, we used the software Final Cut Pro X developed by the company Apple, which allowed us to edit and render the videos recorded using the 4K resolution. In total, 3 hours and 27 minutes of shooting were recorded and edited, contemplating the opening and the 16 scenes of the film.

For the composition of the soundtrack of the film we asked the Instituto Elpídio dos Santos to use the compositions of the artist of the same name. Popularized for being soundtracks of Brazilian cultural films (as in "Casinha Pequenina", product for Mazzaropi), the songs of Elpídio dos Santos accurately expressed the intention of the short.

Cuttings were mostly dry and short that brought dynamics to each scene, which contrasted with the proposal of film without speech. We corrected the color, saturation and exposure of the video, producing a temporal continuity, we also put fade in and fade out e effects on video and audios, starting and ending each scene.

34.4 Results

After a strenuous work of production, recording and editing, we have a work that ful-fills its purpose of raising awareness about the problem of non-ionizing radiation, as could be observed during developmental processes. In addition to this, the film also includes the perspective of the interdisciplinarity Connection of Knowledge, where the fields of Engineering, Theater, Cinema, Education, and so on are linked and exploited in the academic development of participants, both the PETEEECS and Engemulti.

With the completion of this material that treats in a clear, objective and cultural way the problem of non-ionizing radiation emission, we have a very broad content that retakes the discussion with society in a balanced and efficient way, appealing to more didactic means of communication and popular, which makes accessible the available scientific knowledge.

Throughout the development of the film “A Troca”, it was very clear within the group that participated in the creative process, as well as of those who were observing, that curiosity about the subject was aroused, which brought much satisfaction and fulfillment of purpose in the the creation of the film.

Being an Environmental film produced by students and teachers of the

Engineering area, all stages of the film's execution involved disparate areas of knowledge, in consonance with the cultural and regional promotion of Goiânia and the City of Goiás. All this interdisciplinarity, was very enriching to participants who not only assimilated theoretical but also practical concepts from very broad fields.

Undoubtedly, as it was verified, the students of the PETEEECS, were brought into contact with the Theater and the Cinema, developing extracurricular skills, not approached within the traditional academic structure. In addition, those involved explored new shooting technologies such as the 4k and the drone used in filming, as well as editing techniques later applied during the film's set-up. A wide range of knowledge could be encompassed throughout the creative process, so it is clear that the film was fully enriching for the participants.

34.5 Conclusion

The success of the production of the film "A Troca" was great. Thus, before the public exhibition of the film, the script for the film "A Troca" was registered at the Escritório de Direitos Autorias (EDA) of the Biblioteca Nacional (BN) of Rio de Janeiro, Brazil [3].

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CHAPTER 35

The Course of Introduction to Engineering from The CDIO Initiative at UNISAL (Brazil)

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Abstract: The introductory course provides a framework for Engineering practice as a broad outline of the tasks and responsibilities of an Engineer and

the use of disciplinary knowledge in performing those tasks. Students should engage in Engineering practice through problem solving and simple design exercises, individually and in teams. The course should also include the knowledge, skills and attitudes of personal and interpersonal skills, developing those that are essential at the beginning of a program to prepare students for more advanced experiences of producing products, processes, and systems. Introductory courses aim to stimulate students' interest in, and strengthen their motivation for, the field of Engineering by focusing on the application of relevant core Engineering disciplines. Students usually elect Engineering programs because they want to build things, and introductory courses can capitalize on this interest. Among the various logical disciplines, components of the basic core of Engineering courses involving Calculus, Physics and Linear Algebra, among others that characterize the initial learning of the Engineer, the Introduction to Engineering, commonly established in the first semester, highlights the summary of what will be the learning process in the development of any Engineer preparing for the professional market. Personal and interpersonal characteristics besides all the technical and professional knowledge involved must understand the direction of any specialty of the Engineering establishing activities of teaching both theoretical and practical including its process of evaluation. In view of this scenario, the Salesian University Center of Sao Paulo (UNISAL) at its Lorena Unit, created its Engineering courses thinking precisely on the purpose of developing students through active learning. Due to the Country Curriculum Guidelines, the Industrial Engineering course has in its basic matrix this introductory course. With the inclusion of the discipline in the other specialties offered by the institution from 2017, a content was proposed in which project management concepts and elements established by the CDIO INITIATIVE as well as presenting how was the historical development of Engineering and its teaching process directed to each specialty including its subareas. Thus, this paper presents the improvement of the teaching-learning process of the course in the Industrial Engineering course, including contents and assessments in order to establish a direction to the other specialties in Engineering offered by the institution, thus strengthening the model proposed by the CDIO Initiative in order to develop the necessary skills to the Engineer from the beginning.

Keywords: Introduction to Engineering, Projects, Content, Assessment, Standards 4.

35.1 Background

Among the various logical disciplines, components of the basic core of Engineering courses that characterize the initial learning of the Engineer, the

Introduction to Engineering, commonly established in the first semester, highlights the summary of what will be the learning process in the development of any Engineer preparing for the professional market. Personal and interpersonal characteristics besides all the technical and professional knowledge involved must understand the direction of any specialty of the Engineering establishing activities of teaching both theoretical and practical including its process of evaluation. In view of this scenario, the Salesian University Center of Sao Paulo (UNISAL) at its Lorena Unit, created its Engineering courses thinking precisely on the purpose of developing students through active learning. Due to the Country Curriculum Guidelines, the Industrial Engineering course has in its basic matrix this introductory course. With the inclusion of the discipline in the other specialties offered by the institution from 2017, a content was proposed in which project management concepts and elements established by the CDIO INITIATIVE as well as presenting how was the historical development of Engineering and its teaching process directed to each specialty including its subareas. Thus, this paper presents the improvement of the teaching-learning process of the course in the Industrial Engineering course, including contents and assessments in order to establish a direction to the other specialties in Engineering offered by the institution, thus strengthening the model proposed by the CDIO Initiative in order to develop the necessary skills to the Engineer from the beginning.

35.2 Context

In the context of the Engineering teaching proposed by the CDIO INITIATIVE, the introductory course is fundamental to direct to the incoming students how will be the process of developing the skills throughout the course through practical activities that will be experienced in the professional life.

According to Crawley, Brodeur & Soderholm (2008), the introductory course provides a framework for Engineering practice as a broad outline of the tasks and responsibilities of an Engineer and the use of disciplinary knowledge in performing those tasks. Students should engage in Engineering practice through problem solving and simple design exercises, individually and in teams [1]. The course should also include the knowledge, skills and attitudes of personal and interpersonal skills, developing those that are essential at the beginning of a program to prepare students for more advanced experiences of producing products, processes, and systems.

The objective of this paper is to present how the Introduction to Engineering discipline evolved from the institution's entry into the CDIO INITIATIVE within the Industrial Engineering course and its dissemination to other specialties offered at UNISAL.

35.3 CDIO INITIATIVE - UNISAL

For the case of the Salesian University Center of São Paulo (UNISAL) in Brazil, based on interdisciplinary projects throughout all semesters of the curricular matrices of the different specialties, the discipline is the starting point for contents and procedures related to project management. Group activities to solve problems and the use of the communication process from the beginning provides the student with important characteristics for the development of the Engineering course.

With the institution's entry into the CDIO INITIATIVE in 2016, the content of the course was reviewed in order to meet the characteristics of the training in Engineering. One of the works developed for the students was to verify what the other participating institutions of this world organization did for each of the established Standards and to compare with what UNISAL was proposing in its actions for the learning process of Engineering. To disseminate this content, a seminar was held for students to share the experiences of various Universities.

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CHAPTER 36

Responsible Research and Innovation-RRI: A Reflective Study on Its Application by The European Union

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Abstract: The study refers to an analysis of Responsible Research and Innovation – RRI and its application in the European Union - EU and its relation with Brazilian research, since little is known on the subject. Objectives: to know the policies of RRI and its contributions to researchers and policy makers public manager to use it as innovative in scientific research, with a view to possible solutions to social problems, since RRI promotes change and contributes to scientific development. Method: This is a documentary research, of qualitative analysis based on the collection of information, spreadsheets and statistical graphs, opinions, agreements, reports, websites, edicts, news and official documents. The approach is divided into two stages, the first of a literature review on RRI, and the second, the analysis of information and data collected in insti-

tutional departments. Results: the six major Agendas created and instituted by the Commission of the European Union have thematic strategies of organization of the integrated work of development of scientific researches such as: Ethics, Gender Equality, Governance, Free Access, Public Engagement and Scientific Education. The survey data revealed that in 2013, Brazil invested only 1.3% of its GDP in research and development, about US $ 31 billion and ranks 10th in the absolute investment ranking. In the years 2014 to 2015 Brazil did not invest much in research, and in 2016, the figures were even lower than the previous year. In the member countries of the European Union, this reality is different. Of the twenty-eight countries, Finland, although ranked 26th, increased its percentage of GDP from research investment to 3.6%, about $ 7 billion in 2013, highlighting how the country who invested more in research. In Portugal the support for scientific research has an organization of management and investments through an institution to support the scientific community, through different financing instruments, destined to scientists, research teams and R & D centers. Conclusions: it was clear from the findings that it is possible to develop research using the themes proposed by the indicated EU agendas as a tool for innovative scientific research to find solutions to major social problems. And that, in doing so, be open and transparent, engaging society and making the results of public domain research available to the public. It was found that the RRI as a strategic and innovative resource, supports and allows the alignment of responsible research, with transparent results and reach for all, besides being a reflexive practice of innovative research that benefits the whole society. However, the information provided in this study will serve the initiatives of scientific investigations and strategies of search of new ways to solve the great world problems.

Keywords: Science, Education, Innovation, Strategies, Responsible Research.

36.1 Background

The study refers to an analysis of Responsible Research and Innovation – RRI and its application in the European Union - EU and its relation with Brazilian research, since little is known on the subject [1-18].

36.2 Purpose/Hypothesis

Objectives to know the policies of RRI and its contributions to researchers and policy makers public manager to use it as innovative in scientific research, with a view to possible solutions to social problems, since RRI promotes change and contributes to scientific development.

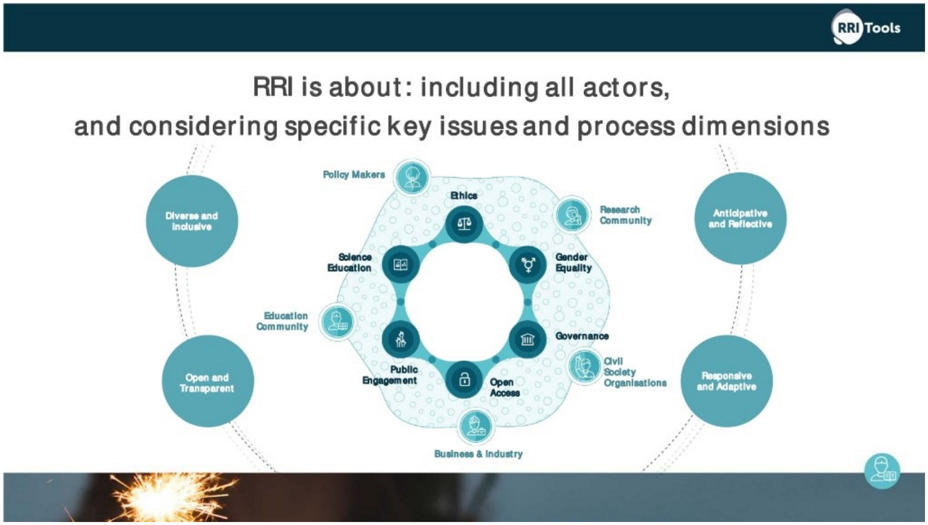

Figure 36.1 – Structure de RRI.

36.3 Design/Method

This is a documentary research, of qualitative analysis based on the collection of information, spreadsheets and statistical graphs, opinions, agreements, reports, websites, edicts, news and official documents. The approach is divided into two stages, the first of a literature review on RRI, and the second, the analysis of information and data collected in institutional departments.

36.4 Results

The six major Agendas created and instituted by the Commission of the European Union have thematic strategies of organization of the integrated work of development of scientific researches such as: Ethics, Gender Equality, Governance, Free Access, Public Engagement and Scientific Education. The survey data revealed that in 2013, Brazil invested only 1.3% of its GDP in research and development, about US $ 31 billion and ranks 10th in the absolute investment ranking. In the years 2014 to 2015 Brazil did not invest much in research, and in 2016, the figures were even lower than the previous year. In the member countries of the European Union, this reality is different. Of the twenty-eight countries, Finland, although ranked 26th, increased its percentage of GDP from research investment to 3.6%, about $ 7 billion in 2013, highlighting how the country who invested more in research. In Portugal the support for scientific research has an organization of management and investments through an institution to support the scientific community, through different financing instruments, destined to scientists, research teams and R & D centers. Table 1 shows the percentages of GDP investment in surveys in 2013.

Table 36.1 – Indices of investments.

Conutry	% of GDP in research and development	US$	Absolute Investment Rank (2013)
Finland	3,60%	US$ 7 billion	26º
Sweden	3,40%	US$ 14 billion	17º
Denmark	3%	US$ 6 billion	28º
Germany	2,80%	US$ 92 billion	4º
Austria	2,80%	US$ 10 billion	21º
France	2,30%	US$ 52 billion	6º

36.5 Conclusions

It was clear from the findings that it is possible to develop research using the themes proposed by the indicated EU agendas as a tool for innovative scientific research to find solutions to major social problems. And that, in doing so, be open and transparent, engaging society and making the results of public domain research available to the public. It was found that the RRI as a strategic and innovative resource, supports and allows the alignment of responsible research, with transparent results and reach for all, besides being a reflexive practice of innovative research that benefits the whole society. However, the information provided in this study will serve the initiatives of scientific investigations and strategies of search of new ways to solve the great world problems.

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CHAPTER 37

Environmental Education as A Strategy to Reduce Electric Energy Consumption: An Approach at A Municipal School in Goiânia, Goiás, Brazil

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Abstract: Environmental Education is an important tool for raising awareness about water waste, energy consumption, emission of pollutants, among other aspects. It is generally verified that users of public buildings have a lack of concern regarding the consumption of natural resources arising from the use of the building, among them electric energy, since the financial costs of maintenance are the direct responsibility of the public coffers, still that indirectly the entire population contributes to the payment, through taxes. In the municipality of Goiânia, Goiás, Brazil, for example, municipal public educational buildings correspond to approximately 30% of the electricity consumption. The main objective of this study was to develop environmental education strategies and implement energy efficiency actions to reduce the consumption of electricity in a public school in Goiânia. The methodology used was based on research-participant, environmental education together with replacement of lamps by LED system (Light Emitting Diode) at strategic locations in the building and monitoring of results. The actions carried out included the lamp replacement, and educational lectures offered to students of different age groups in three school shifts with a partnership of employees and teachers of the municipal school selected on energy efficiency and strategies to reduce the consumption of electricity. The project mobilized directly about 200 people belonging to the target audience and indirectly 800 students who were part of the teaching unit. It was collected a data base among 2012 to 2016. The methods of data collection and analysis were based on documentary research, analyzing the electric energy bills of the building, as well as documents and legislation of the municipality itself on the consumption of electric power and the architecture model applied to school environments in Goiânia. The results obtained, after a monitoring period of six months (November to April) during the years 2016 and 2017, indicated an analyze to reduction of 16% of the consumption of electric energy in the building, compared to the same period in the previous year. Therefore, this result regard to the possibility of investments in energy efficiency projects for public buildings in the city of Goiânia.

Keywords: Electricity Consumption, Energy Efficiency, Environmental Education, Light Emitting Diode, Public Buildings.

37.1 Background

Brazil is identified as one of the precursors to the development of efficient energy alternatives, as well as the implementation of instruments that allow the use of energy in a correct way, not only for public buildings, but throughout the entire production and energy consumption level [1]. According to the Energy Balance of 2017 [2], in the country, existing buildings accounted for 51.1% of electricity consumption, with the public accounting for 8.3%. With the growing demand for electric energy in Brazil and the need to implement environmental sustainability practices, it is necessary to make efficient the use of the electric energy produced, as well as to encourage the rational consumption of it. Since energy generation depends on environmental conditions (renewable sources) and scarce resources (non-renewable sources) that can lead to a series of social and environmental impacts [1-2].

The electric energy crisis that occurred in 2001, called the Blackout Crisis, led the federal government to implement a rigorous rationing policy and pointed to the need for better policies and investments in the energy sector. Considering this context, Lamberts (2014) highlights the opportunity of investments in studies and proposals that allow the awareness of users and reduction of electric energy consumption based on energy efficiency and environmental education projects [3].

Thus, this study was based on the adoption of educational practices to reduce the consumption of electric energy by stimulating users by correctly using the resources available in a public education unit. In addition, it is known that the strategies in energy efficiency allow the reduction in costs, modernization and readjustment with the use of new equipment with greater performance and durability. In addition, efficiency actions can expand to 324 buildings in public education units in Goiânia.

37.2 Purpose/Hypothesis

The purpose of this study was to develop strategies to reduce the consumption of electric energy in a Municipal School of Goiânia by replacing lamps, environmental education and monitoring of results. In view of this, the following specific objectives were listed: Analyze the consumption of electric energy in a public school building in Goiânia/GO; Develop actions to reduce the consumption of electric energy through environmental education actions; Monitor the reduction results in a given predetermined time interval.

37.3 Design/Method

The selected municipal education unit is in the Northwest Region of Goiânia, verified in Figure 37.1, being this one of the most deprived in socioeconomic terms of the city. The architectural design and construction model follow a "standard" typology adopted in several school units in the municipality. The school runs from Monday to Friday during the three periods of the day and counts on basic education and Youth and Adult Education (EJA).

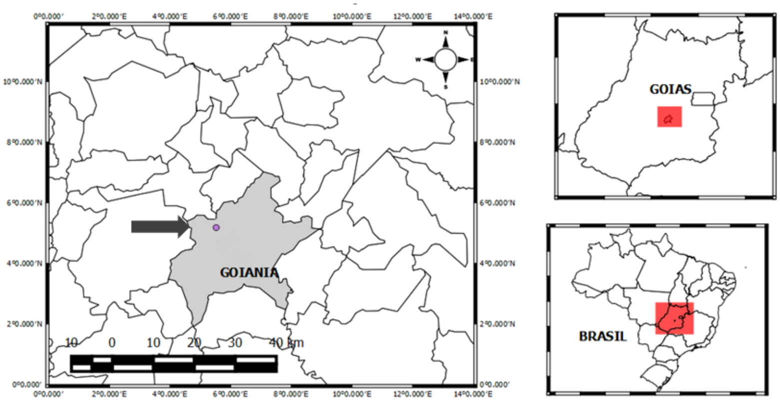

Figure 37.1 – Location of the Northwest Region in Goiânia and indication of the Municipal Teaching.

The study deals with a participant research, which proceeds from an alternative search to the standard of conventional research. Represented by Demo (1995) as a qualitative evaluation of social manifestations, committed to interventions that contemplate self-diagnosis (knowledge, accumulation and systematization of data) and consequent construction strategies to face practical problems detected. The characteristic of this process is shared knowledge between the parties, involving directly the researcher with the participants, in which the communicative action is the essence in the application of the method [4].

In addition, the methodology used was based on environmental education programs based on replacement of lamps by LED systems (Light Emitting

Diode) considering strategic locations in the building and monitoring of results. For the field research, the activities carried out were: visit to the selected building, collection of information necessary for the characterization of the building, contacts with the Municipal Department of Education, verification of prices and information to budget the interventions in the municipal education unit, besides of studies on intervention strategies to reduce energy consumption.

37.4 Results

The school's energy consumption is considered high compared to other schools of the same category. It was found that in part of the lighting system, 60W incandescent bulbs, already banned from the market, were still used.

The environmental education actions were built together with the coordination team in partnership with officials and teachers of the public education unit. Altogether, the project directly mobilized 200 people (students and employees) and indirectly 800 people among different age groups. To promote this stage, the activities were divided into two days (29 mar. 2017 and 17 apr. 2017), and the first day was the talk and activities with the students of the Youth and Adult Education (EJA), teachers and night staff. The presentation was technical-informative with the objective of boosting the consumption of conscious energy in the public building and publicizing the results achieved with the lamp replacements. On the second day, the activities were aimed at children from 9 to 11 years of age in the morning, and children from 5 to 6 years of age in the afternoon.

From the actions taken and changes in the lamps - 52 fluorescent tubes 40 W, 8 incandescent bulbs 60 W and 2 fluorescent bulbs 40 W and reactors 15 W by the system of LED lamps with 18 W and 10 W -, there was a reduction of 16% of the consumption of electricity, monitored for six months and evaluated in comparison to the consumption of the previous year. Approximately US$ 850.00 was invested to replace bulbs and developed activities.

The materials used were donated to the school after the accomplishment of the activities, among: banners, stickers and, personalized t-shirt. In addition, the strategy of distributing gifts for children and adults in all events was used as part of group activities.

The results evidenced the satisfaction of the young adults and children in participating in the activities, as evidenced by the completion of a satisfaction form, in addition to the contribution of new information. In general, both adults and children participating in the activities have demonstrated notions about the need to adopt responsible practices for saving electricity at their school and elsewhere. Despite this, only half of the young-adult students portrayed the application of energy conservation knowledge in their daily lives [5].

37.5 Conclusions

After performing the environmental education actions and lamp changes by LED luminaires in three classrooms and block corridor, the monitoring carried out between six months of the year 2017 indicated a reduction of 16% in the total energy consumption of the building compared to last year.

The environmental education actions carried out with the students of the school emphasized the importance of linking the social side with environmental issues, regarding the saving of electricity in public buildings, improving the daily bond between students, employees and teachers. Also, the relevance of performing such activities in the educational context was verified in these activities, given the enthusiasm shown by the participating students.

In view of the above, it should be noted that the activities developed had the good involvement and satisfaction of the students and school staff. It is hoped that such results can be used by municipal public administration, subsidizing project actions in energy efficiency and/or environmental education in the public sphere, retrofit and maintenance of public buildings; stimulating the public power to adopt normative instructions for this purpose.

Finally, from the closing of the activities, all those involved expressed interest in behavioral improvements and preservation of natural resources in the expectation of minimizing the effects that man's actions have on nature and ensuring a balanced and quality environment for the current and future generations.

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CHAPTER 38

Developing Student Leadership through Experiential Learning

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Abstract: In a world where technology is changing every single detail of our societies, schools, and organizations in a skyrocketing speed, it is worrying that the way we develop our leaders is improving so slowly. With numerous studies showing that leadership is one of the factors that impact the most on software projects' success, it is worrying that more than $14B are spent yearly with leadership development and, still, most organizations believe they are not being effective.

One of the most efficient methodologies for leadership development inside companies is the Experiential Learning from David Kolb, but it still has some problems in gaining traction inside Universities due to their difficulty of simulating practical experiences. Contrary to most of MBA students that usually work during their programs, already occupying management positions technology students frequently struggle to implement what they learn on leadership courses in their professional or personal lives. Because graduate students are mostly full-time and have zero or little leadership experience and have limited occasions to apply the leadership concepts they learn, they were the main focus of this study.

From the literature review, it was evident that many different approaches for teaching leadership have been tried inside Universities with various results and little standardization is perceived on the way they were used. For this reason, this study proposes a framework based on Experiential Learning for using group

activities as a means to help technology students practice leadership skills. A first pilot was executed with pleasant results and feedback from students: 91% of them enjoyed the group activity and most of them felt they practiced important leadership skills and that this could improve their effectiveness as future leaders.

Nonetheless, because this pilot was run with a small group, with limited time and resources, it must be replicated in other contexts, with other group activities and larger groups to gather more data for a concrete basis for the suggested framework. Exploring these other scenarios could be strongly considered as a future work, to increase its validity and enable it to be used among other Universities.

Keywords: Leadership Development, Experiential Learning, Group Activities, Technology Leaders, Software Management.

38.1 Background

Combined with the inevitable digitalization of most markets, the cumulative complexity of software systems, and the globalization of teams, tech organizations are also facing new leadership challenges in the 21st century. This context explains one of the reasons of why almost U$14 billion is spent yearly on leadership development only in US itself and increasing around 14% year-over-year [1].

The other aspect is that the ways these professionals are developing their leadership skills are not being effective enough for all the above mentioned challenges. In spite of all this investment, a study by Bersin shows that almost 75% of leadership teams still fail to achieve business goals [2] and a global survey done by Deloitte shows that 86% of companies consider leadership not only as their highest-priority issue but also the one with the largest gap to be fulfilled [3].

For this reason, it is imperative that both companies and Universities assess and improve their ways of developing and teaching leadership, respectively. This study, however, focused on the latter.

38.2 Purpose/Hypothesis

This work considers leadership as a powerful means to tackle the essential human difficulties of software development, which is also supported by other studies that have shown that appropriate leadership not only decrease the risk of project failure but also significantly improve teamwork and staff productivity [4]. Therefore, improving the way technology Universities are teaching leadership today is a promising long-term endeavour to increase the success rate of software projects.

The purpose of this study is to evaluate how Kolb's Experiential Learning could be used to give technology students a more practical experience on leadership courses taught in graduate schools. From this objective, arise the following research questions:

1. How are professors teaching leadership in technology Universities?
2. What group activities are they using?
3. How to use the Experiential Learning Theory to teach leadership?

38.3 Design/Method

Initially, a secondary research was done in order to better understand how professors are currently teaching leadership and if they are using any kind of practical activities to enhance student's learning. After the Experiential Learning Theory [5] was adopted, a literature review was done to gather knowledge around this subject.

Then, a list of leadership group activities was compiled and one of them selected to be implemented using the ELT framework. A few details of the activity were slightly modified to match the new structure, but the general idea of the activity remained the same.

Following an Observational Methodology, the selected group activity was executed with a small number of students (N=12) and entirely recorded on video, in order to allow a comprehensive Interaction Analysis (i.e. not only dialogs, but also gestures, usage of the provided materials, and body language) among the students and how the leadership process actually occurred and changed over time.

After the execution of the pilot, all the findings and results about the use of this framework were collected and discussed, to later be incorporated on the final model proposed.

38.4 Results

Because the time and resources for this study were limited, the activity was planned for a small group of students (N=12), just as a pilot to evaluate how easily the framework could be adopted and what would be the difficulties on using it.

The feedback shows that virtually all the students (91% with 0.27 deviation) enjoyed the activity and only 3 of them (25% with 0.91 deviation) were not sure on how it could improve their effectiveness as leaders. They found that the most practiced skill was Team Work (0.59 deviation) and the least was Communication (0.37 deviation).

The fact that this experiment was conducted outside the context of a Leadership course might have impacted on the answers, once they probably didn't have a clear view of what exactly they were learning, how to apply these skills in real life, and how they could improve their effectiveness as leaders. For this reason, these results need to be revalidated by professors in leadership courses in order to assure their accuracy relative to the real environment.

38.5 Conclusions

This work had the modest ambition of merely presenting a realistic and structured alternative that is just better than the traditional way of teaching leadership, with a framework that is both effortless and inexpensive to apply, without needing vast cultural changes on the University or large budget approvals.

Among the limitations of this work, there were little time and resources to conduct more complete experiments with a larger number of activities, to compare the similarities of the results and discuss the particularities of each. And once the framework was built from the lessons of a single experiment, it still lacks significantly more validation in order to be widely adopted in technology Universities.

Nonetheless, the students' evaluation of the pilot was certainly positive. The

Interaction Analysis showed that the students truly dived into the experience and it is reasonable to predict that on a more complete leadership course they would feel even more confident to have practiced what they learned.

For this study to be well accepted by the academy, these experiments should be replicated with larger groups, more activities and other contexts. Therefore, this would be the biggest priority for a future work, where it could also analyze which activities were most effective and the impact on these students in the long term, when they are already leading.

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CHAPTER 39

Reception of The Fledglings of The School of Engineering Challenges and Perspectives

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Abstract: The Núcleo de Engenharia Educacional (NEED) together with the Es-

cola de Engenharia of the Universidade Federal do Rio Grande do Sul - UFRGS develops at the beginning of each semester the project entitled “Reception of the Fledglings of the Escola de Engenharia: Challenges and Perspectives” with the intention of presenting the School of Engineering, Courses, Projects in progress and / or realized. In this sense, the project aims to encourage the continuous improvement and innovation of Engineering Education through the development of innovative teaching practices. As a proposal, the project “Welcoming the Freshmen - Challenge UFRGS” - 2017/1. The project houses a set of projects and activities of various modalities related to current needs, technological changes and career challenges. In addition, challenges are proposed based on the 17 UN Sustainable Development Goals. The formation of the groups was made up of interdisciplinary groups so as to enable the academic to interact in other areas of knowledge, seeking alternatives, interventions, continuous improvement, sustainability solutions, use of existing resources or the improvement of them. For the presentation of the projects a workshop on PITCH was held, which consists of a brief presentation of three to five minutes where it should present the justification of the project. The evaluation consisted of presentation, team competencies, problem, solution, market size, revenue potential and business model. The general objective is to promote the discussion about the need to improve the training and professionalism of professionals, and the absorption of new technologies through the exchange with other centers of knowledge and research. In order to better conduct its actions and projects, NEED is forming networks of collaboration with other educational institutions, or engaging in activities related to Engineering, in the development of actions and solutions to common problems and needs.

Keywords: NEED, Engineering Education, Sustainability, Environmental Education.

39.1 Background

In order to better conduct its actions and projects, NEED is forming networks of collaboration with other educational institutions, or engaging in activities related to Engineering, in the development of actions and solutions to common problems and needs. It is also intended to make a significant contribution to increasing the interest of young people in the field of Engineering and, in addition, to hold a program of lectures that includes the discussion on national themes related to Engineering, as they have aroused interest in academics, which thus obtain answers to some questions, such as salaries, attributions, responsibility, environmental issues, work done by veteran scholars, among others. The dissemination of such a program is associated with the characteristics of the labor market of engineers in the various regions of the country. The purpose of the project is to involve and encourage, create, plan and design innovative projects aiming at sustainability. The analysis of the project aims to help in planning, intervene with methodologies that allow the academic to observe, idealize, prototyped and unite diverse perspectives of problem, prioritizing the collaborative and multidisciplinary work. And, in addition, to enable the academic: vision, leadership, energy, knowing how to listen and argue, networking, ability to solve problems and to innovate, to know how to work in a team and to master other languages [1-8].

39.2 Hypothesis/Method

The project was carried out in two stages. First, a series of lectures about the 21st Century Engineering Challenge: sustainability and new technologies was held to an audience of 250 freshmen from the 13 Engineering Courses offered by the School of Engineering. Afterwards, projects from students from the Energy Engineering, Engineers without Borders Enactus and Engineering School Athletic Association courses were presented. In the same day the School of Engineering freshmen were challenged about "How to make UFRGS more sustainable?", based on UN's 17 Sustainable Development Goals. - SDG. The freshmen were split into multidisciplinary groups to help them interact with other areas of knowledge in order to seek solutions for the presented problem, aiming at possible interventions, continuous improvement, solutions favoring sustainability and utilization or improvement of preexisting resources. The interventions put forward for the challenge consisted in creating or improving a service, process or creating a product that incorporates concepts of sustainability.

39.3 Results

A PITCH workshop was held for the presentation of the projects, in which participants prepared a 3 to 5 minute presentation outlining the project the opportunity in contemplates, reason, and execution in a succinct and objective format. 12 groups of 5 students from the 13 different courses offered by the SE participated in the project, thus enabling the formation of multidisciplinary groups. Based on the challenge that was put forward, the freshmen presented their PITCH to an examining board composed of three specialists in the fields of Entrepreneurship, Startups and Businesses, who evaluated them on their presentation, team competences, problem, solution, market size, income potential, and business model. Out of the 12 projects, 5 were distinguished. They were: Automated Ticked – a program that consists of an automated billing system at the University Restaurants, using the already existing UFRGS card. This project also proposes the implementation of automated systems in the library and other places an access control system might be needed; Illuminated Campus – which aims to create an alternative light post using cheaper and sustainable materials, such as PVC pipes and recycled materials, making it economically viable; Smartrash – a project to install electronic devices in trash cans to inform cleaning staff when they're filled to capacity; Eco-Ar (a project that aims to use geothermal energy to cool environments); and Collective University Transport (TCU), a carpool mobile app.

39.4 Conclusion

Due to the adhesion by the courses, as well as the presentation and the elaboration of excellent works on the part of the School of Engineering's freshmen, the project will be extended, that is, it will now be executed in all semesters, thus enabling the freshman to think, calculate, enterprise, innovate and develop projects that tackle environmental questions, current demands, as well as raise the interests to areas of knowledge related to Engineering. It also strengthens the sharing of knowledge between freshmen and upperclassmen because the upperclassmen serve as mentors for the projects. Finally, we highlight the importance of improving Engineering education in light of technological developments and new demands given rise by them.

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CHAPTER 40

Rational Use of Water Booklets Used in Education Campaign

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Abstract: Water is an essential liquid both for the preservation of life and for development. Thus, measures that contribute to its rational use are very important, because the supply of drinking water is decreasing while demand is growing. In recent years this issue has been of concern to many researchers and others. In this sense, eight editions of the World Water Forum have already been held. The first was held in Marrakesh, Morocco in 1997, where the role of drinking water in sustainable development was discussed. The eighth edition of the World Water Forum, the largest among them, was held for the first time in the Southern Hemisphere and was held in Brasília, the capital of Brazil, between March 17 and 23, 2018 with the theme “Sharing Water”. In 2015 a project for the control and rational use of water and electricity was implemented at the headquarters of the Regional Council of Engineering and Agronomy of Goiás. In this project the use of the water released from the air conditioning units was carried out, together with an educational campaign focused on the rational use of water. Thus, this work aims to report on the

preparation and dissemination of booklets used in the educational campaign. The booklets contain a clear and objective set of information that can be applied in commercial and industrial residential buildings. One primer deals with the “rational use of water in cleaning services” and the other guides how to install “system for collecting and storing water from the air-conditioning unit”. In the elaboration, three pillars were considered: transcription of information in a reliable way and to reach a target public with any level of education, including student body of educational institutions; use of clear and objective language; creation of illustrations produced with light and attractive visual. These booklets are digitally available on portals of three official institutions, and hundreds of printed copies have been distributed. A survey was conducted with people directly involved in the educational campaign, and with others who had access to the booklets. The results obtained were highly positive, demonstrating satisfaction and commitment to disseminate the instructions contained in the booklets, including demonstration of stimulus to adopt procedures in other situations that result in effective combat to waste of water. From the work can be related the following conclusions: The positive evaluation of the content and form of the instructions contained in the booklet shows that this material was produced technically correct, reaching the proposed objective; The good understanding and commitment to practice the messages made available indicate an important contribution to the appropriate ways of using water; The booklets were the means for educational actions related to the rational use of water and, consequently, are helping to reduce rationing actions.

Keywords: Booklet, Combating Waste, Educational Campaign, Rational Use, Water.

40.1 Background

The industrial production of a country has direct dependence on the availability of electric energy. It is known that industrial production generates jobs contributing to poverty reduction and increase of gross domestic product.

For the exposed electric energy is an input of fundamental importance for both development and generation of wealth. In Brazil, electricity from hydroelectric power plants constitutes the largest share of the total generated [1]. Several hydroelectric power plants are currently being built [2]. It is worth mentioning that the low levels of water in the reservoirs of power stations at certain times in recent years have been of concern to Engineers and researchers in the field of Engineering, especially those in the electrical Engineering modality.

It is a fact that in recent years the concern with water is not limited only to the issue of electricity generation, but also to the one destined for human consumption whose availability depends on the climatic conditions. This issue has been discussed at the World Water Forum [3].

Regarding climatic conditions in the State of Goiás and the Federal District, there is basically a dry season that includes the dry season, and the wet season characterized by the rainy period [4]. In the dry season when the availability of fresh water reduces, due to the low levels of the reservoirs and the increase in the demand for the human consumption that normally happens, has caused a compromise of the supply of certain urban centers [5].

For the exposed actions aimed at the rational use of water, including educational campaign, is very important. It is worth mentioning that it is interesting to use water from an alternative source [6].

40.2 Purpose/Hypothesis

The purpose of this work is to present actions related to the elaboration and implementation of educational booklets on good water use practices developed in a research project that contemplates the theme 'rational use of water and implementation of collection and storage system using alternative source'.

40.3 Design/Method

To combat waste, a project aimed at the control and rational use of water and energy was implemented at the headquarters of the Regional Council of

Engineering and Agronomy of Goiás (CREA-GO) in 2015, which was called Project CURAE CREA-GO. This building is used as an element of the study presented here.

The methodology adopted was the first step in the development of an educational campaign with an emphasis on sustainability, based on dialogues, lectures, posters and stickers, with the participation of all employees of the municipality.

A mobile water transport device has been applied capable of measuring the volume of water used. In a second phase of the research, two other institutions were involved, with a reasonable number of employees, one public and one private. Using the strategy of observation and dialogue it was possible to verify the existence of several vices practiced, similarly in the three institutions, during the accomplishment of the tasks with the water. Considering the philosophy of Paulo Freire and the problems observed, two educational guides were elaborated.

To evaluate the mechanisms used in the educational campaign, questionnaires were used in the model to indicate the answers of the questions without the identification of the evaluator.

40.4 Results

There was a significant participation of the employees through attendance at the lectures and the commitment to practice and disseminate the recommendations suggested also in environments other than that of the workplace.

The two elaborate booklets, an important component in the educational campaign, had as a target audience people of the most different levels of schooling. One primer deals with the collection and storage of water from the evaporators air-conditioning system, and the other is about the rational use of water in cleaning services as exemplified in Figure 40.1 which shows the cover and one of the internal pages.

Reduction of the time of execution of certain tasks of cleaning making possible the accomplishment of others that previously was not possible in the daily journey.

40.5 Conclusions

The educational campaign, including the use of a primer, involved reducing the volume of water used and consequently reducing financial disbursement.

Proper use of water transport has reduced the possibility of a work accident by eliminating long journeys over wet areas.

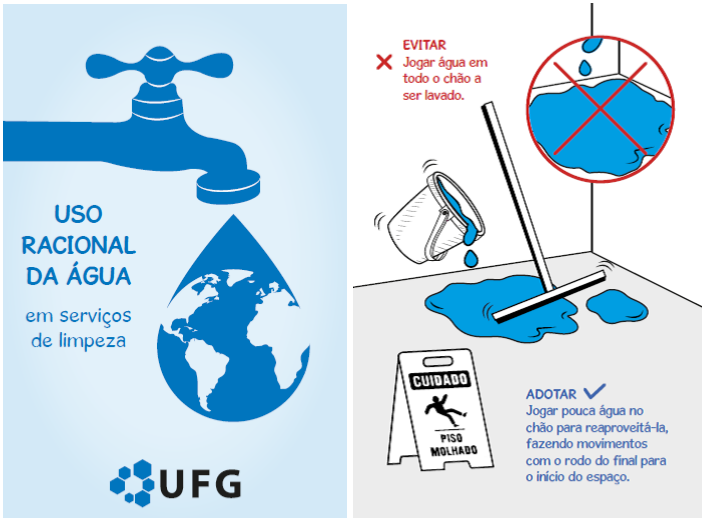

Figure 40.1 – Cover and one of the pages inside the same booklet.

With the new strategies it was possible to reduce the time to perform certain tasks allowing the accomplishment of others that were not possible in the daily journey.

The educational actions provided with the means put into practice were essential for effective combat to waste.

Positive evaluation, through the questionnaires made available, of the lectures and the didactic material provided shows the good understanding of the messages made available contemplating the project objective.

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CHAPTER 41

Semi-Attending Robotics Course Through an On-line Platform Using Lego Mindstorms Ev3

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Abstract: The absence of participatory methodologies in the educational formation of individuals is still a reality in the current teaching methods used in most schools. The traditional method of schooling, where a teacher is responsible for transmitting knowledge and the students merely receive information, is how students of all schooling levels are taught; this manner of schooling is outdated and must be changed. Robotics is an device that has been increasingly raising the interest of young people and adults. It can be used as an interactive schooling tool, thus modernizing the way of teaching. The present work briefly describes the application of a teaching-learning technique which

enables Educational Robotics as a facilitator in the teaching of courses as Mathematics, Physics and Computer Programming. Such courses are seen as too abstract by some students, which may lead them to feel discouraged to further and develop skills in the area of Exact Sciences. Robotics is then used with a goal of awakening the interest of theses courses' students, posteriorly, for the Engineering courses, Engenharia Elétrica and Engenharia de Computação, of the Universidade Federal do Ceará - Campus Sobral. This project was carried out through a partnership between the Instituto UFC Virtual, Secretaria da Educação de Sobral and the Universidade Federal do Ceará, enhancing the schooling methodologies and also motivating the students from the north region of Ceará, particularly from the municipality of Sobral. This work aims to introduce Robotics' general notions through use of the Lego Mindstorms Ev3 Kit, with aid of the programming interface, which is part of the kit (Mindstorms software), and the SOLAR Virtual Learning Environment, where the students watch on-line classes e participate in discussion forums about topics presented by the tutors. The students are challenged to create programs to solve daily-life problems, thus working on their reasoning, teamwork, and the usage of previous knowledge acquired in classroom. Towards the end of the course, when all the students already know how to program the Lego Mindstorms Ev3, it is held a robotics competition as a way of gathering the results obtained through the course. This competition is composed of challenges of different difficulty levels, in which the teams must program the robots to achieve goals set by the organization of the course, being evaluated by guest judges, who have previous experience with Robotics and programming. The teams with best performance are awarded trophies and medals as form of recognition for their effort. All participants are encouraged to continue studying and further the knowledge attained through the course.

Keywords: E-Learning, Logic, Programming, Robotics, Teaching-learning.

41.1 Introduction

Technology diffusion is becoming increasingly fast and accessible to everyone [1-3].

Educational Robotics comes out as a highly effective tool when talking about learning in technology, however it is not limited to technology only. Robotics also encourages teamwork, creativity, problem solving through logical thinking, among other cognitive stimuli. The interest on the topic is instinctively demonstrated when the students are introduced to the Lego Mindstorms Ev3 kit and realize they are capable of programming the robots for solving uncountable challenges.

The present work aims to address robotics as a learning device in the public schools of Sobral, state of Ceará, Brazil. This is accomplished with the aid of the Lego software, which uses a visual programming language and an online platform, named Solar, which allows easy and simple communication between tutors and students.

41.2 The Lego Mindstorms Ev3 kit

The Mindstorms Ev3 is a kit composed of pluggable parts of plastic or rubber, with a very toy-like feel, as it can be observed in Figure 41.1.

Figure 41.1 – Parts of the Lego Mindstorms Ev3 kit.

Among these parts, there is one block, simply called brick, which is programed to execute an algorithm. This block connects to all the sensors, such as reflexive, touch and ultrasonic sensors, as well as the motors. When combining the Lego pieces with the brick, sensors and motors, it is possible to establish tasks to the robots, such as: moving, picking up objects, avoid obstacles, producing sounds, shooting little plastic balls, among others.

Additionally, with the kit it is possible to create and control diverse kinds of assemblies, such as vehicles, animals, musical instruments, among many others.

41.3 Mindstorms Programming Language

The robots programming is done through a visual language composed of blocks. These blocks are combined to shape the algorithm that will dictate the behaviour of the robot. The visual programming language provides to students a more intuitive manner of comprehending the algorithm which they desire to program the robot with, what would be considerably more difficult in common structured languages.

The blocks aforementioned are separated by functionalities, these being: actions, flow, sensors, data operations and advanced blocks. At last, there are customizable function blocks, that is, these can be created to substitute a whole set of blocks for only one, which can be reutilized whenever necessary.

41.4 Course methodology

The course was lectured in a semi-attending fashion, composed of both, virtual classes and inperson meetings. In the meetings, the students used the kits to assembly robots and solve challenges, using the knowledge previously acquired in a practical way.

For aiding the virtual classes, it was made use of an online platform called Solar, which is a website with discussion forums, supporting material hosting, chats, web conferences, schedule and even online tests. Through this website, students could easily interact among themselves or contact tutors.

In the meetings, the students solved challenges proposed by the tutors, making sure that there was a relationship between what was addressed in the virtual activities and what was added in the meetings. Some of these challenges were: “keep going”, where the robot must go straight for some time; ’go and come back’, where the robot must go straight, turn around and come back to the original position; ’Mind the wall’, where the robot must identify obstacles and avoid them, among others.

41.5 Competition

In order to evaluate the results obtained with the course, a competition was held, stimulating teamwork, logical thinking and the ability of solving problems in a quick and objective manner. The students were challenged with tests of different difficulty levels. Each of these tests had a time limit, and at the end of this time, the competitors should demonstrate their results, so they can be graded and awarded by the judges.

41.6 Conclusion

This project made it possible to improve the performance of public school students in classes that uses logical thinking, as well as some other skills, such as teamwork. Of the participants, 85% reported improvement in logical reasoning and faster problem solving.

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CHAPTER 42

Virtual Environment Tool for NonIonizing Radiation Evaluation

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Abstract: In recent years in Brazil, due to technological advancement and the constant increase in user demand searching a better quality of service (voice, video, data transfer), there is an increase in the radio base station number (RBS) installed by the service providers in urban areas of the cities, thus increasing human exposure to electromagnetic fields emitted by the antennas installed in these stations. The possible health problems caused by this exposure are one of the biggest concerns for regulatory agencies of the services that use radio frequency technology. Studies around this subject have been developed since 1974 based on the guidelines of the International Commission for Protection against Non-ionizing radiation (ICNIRP) that are ratified by the World Health Organization (WHO). In Brazil the institution responsible for regulating the radio spectrum and defining the radiation limits emitted by radio stations is the National Telecommunications Agency (ANATEL) and based on Resolution No. 303 of 2 July 2002, which adhered to the ICNIRP standards announced in 1994, this work proposes an evaluation module of non-ionizing radiation levels through the protection zone in a three-dimensional simulator of antennas signal propagation. The module allows the display of the power received by the actors in configurable scenery and provides analysis of distant electrical

field intensity for identification of exposure levels to NIR. This way through this module it will be possible to analyze which areas around the antenna are considered, in accordance with the regulation, safe and livable, as well as it will be possible to know whether the stations are respecting the limits imposed to ensure the Safety of the general and occupational population.

Keywords: Non-ionizing Radiation, Three-dimensional Simulator, Virtual Reality, Exposure Levels, Distant Electric Field.

42.1 Background

In recent years, in Brazil, there has been an increase in the number of users who value the quality of service offered to them, speed in data transfer, voice and video, Internet, among others. In order to meet this growing demand, operators have increased the number of Radio Base Stations (RBS), in city urban areas, thus increasing human exposure to electromagnetic fields emitted by the antennas installed in the RBS.

The possible health problems caused by frequent exposure to non-ionizing radiation contained in these electromagnetic fields is one of the biggest concerns of regulator services that use the radio frequency technology, and since 1974 Studies have been carried out about this subject [1], where they were based on the guidelines of the International Commission On Non-Ionizing radiation protection – ICNIRP ratified by World Health Organization (WHO). In Brazil, based on Resolution No. 303 launched on 2 July 2002 [2], the responsible for regulating the radio spectrum and defining the radiation limits emitted by the radio stations is the National Telecommunications Agency (ANATEL).

42.2 Purpose/Hypothesis

In 2013 a simulator was developed for planning mobile communication Networks (SIMPLARCOM) [3], with the aim of assisting in the mobile communications networks study, signal of antennas propagation and cellular planning. Based the original code of this tool and on ANATEL's guidelines on exposure to non-ionizing radiation (RNI), an extension/module was developed to analyze exposure levels, which the population resident in the vicinity of the transmission antenna is being submitted, by collecting data in the simulation in a virtual reality environment. In the module it is possible to verify the signal level received, the antenna being analyzed, the field intensity, as well as if the area in question is receiving radiation or not. In the module it is possible to verify the signal level received, the antenna being analyzed, the field intensity, as well as if the area in question is receiving radiation or not. If the area is exposed it is shown the limit permitted by ANATEL.

42.3 Design/Method

After the analysis of the state the art and the SIMPLARCOM's original code, was determined that this project would need to go through some steps.

As the tool originally made signal strength collection, equations 1 and 2 were used for power conversion, for analysis of radiation exposure was implemented the propagation model in the free space,and for the evaluation according to the ANATEL's standards, was used the table data with limits for the general population [2].

$$E(dB\mu) = Pr(dBm) + 20log f(MHz) + 77,2G_{\text{iso}} \tag{1}$$

$$V/m = 10^{\frac{dB\mu - 120}{20}} \tag{2}$$

42.4 Results

For testing two scenarios were created, in the first scenario the frequency range used was 10 MHz to 400 MHz and a transmission power of 67 dBm, and for the second scenario the frequency range was between 0.065 MHz to 1 MHz and a transmission power of 88 dBm.

During the simulation it is possible to see in real time the operation frequency, the signal strength received in dBm, the converted values of the transmission power in dBμV, the field intensity V/m, the height of the Receiver, the antenna being analyzed and the message informing if a certain point of the scenario is or is not according to the threshold permitted by ANATEL. In Figure 2 Shows scenarios created for simulation and Figure 3 shows the results displayed by the tool during the simulation.

42.5 Conclusions

With the adjustments made and after the implementation of the particularities concerning exposure to non-ionizing radiation, the module presented in this paper, was able to use structure of the SIMPLARCOM for the creation of environment, configuration of the transmitter antennas and Recipient, data collection and simulation, to assess according to ANATEL's standards, whether a certain area being or not exposed to non-ionizing radiation.

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CHAPTER 43

The Extensionist Actions and the Impacts on the Process of Professional Formation and The Transformation of Society: The Practical

Case of The Nucleus of Social Attention of The Faculty of Engineering (NASFE/UFJF)

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Since colonial times, social inequality is the reality that insists on persisting in the country, even with the great economic advances obtained over the centuries. Faced with these problems, there are several responsible for acting on their resolutions and/or mitigations. The important role of government (federal, state, and municipal), justice, NGOs, and even religious institutions are the most popular forms of action outside the scientific community, but Universities in extension actions to be an important vector for generating ideas and solutions so that we have a more egalitarian society. It was with this in mind that, in 2008 at the Federal University of Juiz de Fora (UFJF), the Nucleus of Social Attendance of the Faculty of Engineering (NASFE) was created to allow the generation of social projects of Engineering and architecture, but also to enable the students to live practical experiences, acting in real cases and developing skills and competences essential for their academic formation. NASFE is currently an extension project that aims at good Engineering practice in order to improve the quality of life of poor communities through the provision of free advisory services to Engineering projects. With the guidance of teachers, students from the 2nd to 10th period of Engineering, Architecture, Arts and Design, and Social Service of the UFJF it is made possible to offer such services. Since November 2016 actions have been developing in partnership with the Center of Legal Practices of the Faculty of Law of the UFJF providing experience in multiprofessional and multidisciplinary activities. In addition to these services, students are organized into sectors to advance the practice of developing leadership skills so that they are able to assume leadership roles in the labor market and in public power. In this sense, NASFE is divided into three sectors: CIA (Communication, Infrastructure, and Service), Human Resources,

and Quality and Projects, each of which is overseen by an academic member. Organization and opening of the requests, training, and management of the members and, finally, development, monitoring, and delivery of projects are the main activities of each sector, respectively. In 2016 and 2017, 71 consultations were carried out, divided into usucapian projects, proletarian projects, regularizations and architectural projects, mapping of risk areas, and technical surveys. Thus, even with the reduced number of students and professors facing the high demand of society for public Engineering, a satisfactory productivity was obtained, as well as allowing members a practical vision of the social responsibility of their future professions. In addition, in view of the great problem of cities with natural disasters, the NASFE-EDUCATION sector was implemented in March 2018 with the aim of promoting prevention through the learning of elementary school children and the school community, regarding social and environmental risks, and to bring up the discussion on the subject and necessary care. The development of educational actions in public schools has partners such as the Fire Department and City Hall of Juiz de Fora.

Keywords: Extension Actions, Public Engineering, Professional Training, Social Responsibility.

43.1 Background

Faced with the Brazilian social scene, where lower classes are deprived of basic services, the assistance of Engineering professionals presents itself as something inaccessible to many people. According to Brasil (2008), there is a law that calls for the right to technical assistance for the design and construction of housing for low-income families [1]. However, reality still portrays something very different, and when faced with a situation, the members of society mobilize, forming organizations that aim to help people who are in a state of social vulnerability through technical knowledge. Communities lacking technical Engineering assistance through socially conscious students are inspired by leadership and social responsability. Thus came the Social Assistance Nucleus of the Faculty of Engineering, NASFE, in 2008, at the Federal University of Juiz de Fora. It is an extension project to offer the low-income community Engineering projects and architecture, developed by students under the guidance of teachers. The action dynamics involves professors and students to process in the mutual and integral formation based on problems in the research, analysis, and synthesis of the information. This is the method of Problem Based Learning (PBL) [2]. According to Barell (2007), the method of searching for knowledge occurs through questioning and research in order to respond to identified problems [3]. In the case of the project in question, the family nuclei of people inserted in a context of social vulnerability.

From the configuration of a nucleus with multidisciplinary and multi-profession teachers the NASFE-Education was incorporated for the maintenance of a school for guidance and awareness of environmental issues. Search-of-the-search of problem-solving in social interaction and in the opportunity to obtain group cooperation and in the development of interpersonal skills. Thus, an action of the nucleus is enriching, since the formation of the Engineer has a social cost that must be rescued through a conscious action towards society [4].

43.2 Purpose/Hypothesis

NASFE's central proposal is to promote the union between the demands of the two profiles identified in the previous item: students seeking practical application and experience of the subjects addressed at their University and families in situations of social vulnerability who are lacking specialized technical advice. Among the projects developed, what has been offered since the creation of NASFE and that still has greater demand is for Usucapião process (is a mode of acquisition of the property and of any real right that is given by the prolonged possession of the thing, according to the legal requirements).

This claim occurs when the landlord claims to own land that has no record in his name. It is common in cases of informal succession of owners, when the land is sold or inherited without a formal registry in a notary's office to prove the new owner; it is a very recurrent situation in the region of Juiz de Fora and even more common among low-income people, because of the lack of information at the time of acquisition, or for financial reasons. Other services are also provided, such as electrical design, architectural adjustment projects, architectural adaptation projects for accessibility, and general technical surveys. The students are directly involved with the projects from the service phase until the final delivery, always with supervision from the guiding teachers. In 2018, the NASFE-Education emerged from the perception that many of the problems identified during the visits of the nucleus itself could be avoided or mitigated if the population served had knowledge of simple practices related to environmental behavior. Thus, activities aimed at raising the awareness of society are promoted, more directed to actions within schools, with the objective of creating a more sustainable and where the ideas addressed will inevitably be taken to the homes, through the children, also influencing adults and positively impacting the society.

43.3 Design/Method

With 10 years of operation and in constant evolution, currently the nucleus is coordinated by a teacher, two tutors, external collaborators and students of civil Engineering and environmental, architecture and urbanism electrical, and social work, and arts and design courses. The students are organized in four academic supervisions based on the profile, the area of formation, and the interest of the student: Human Resources and Quality; Communication, Infrastructure and Attendance (CIA); Project Sector; NASFE-Education with the aim of developing skills such as: planning, supervising, designing, and coordinating Engineering projects and services; identify, formulate and solve Engineering problems; to act in multidisciplinary teams, among other competences cited in the CNE/CES Resolution (2002) [5]. NASFE also has a partnership with the Center of Legal Practices at UFJF for purposes of interdisciplinary orientation in cases that involve legal issues, such as *usucapião* process, and there is a reciprocal consultation according to the specificities of the cases served by the two nuclei. A request for assistance can be opened with the NASFE by families that have income of up to three minimum wages

43.4 Results

The sectoral management started in 2017, and as well as the development of activities linked to the nucleus, this has made a broader involvement with society possible, which is visible from the increase in attendance and new actions of NASFE-Educação. Between 2008 and 2016, an average of 12 projects were received annually, and in the year 2017, 25 projects were completed. Through these changes, we can cite as results the increase of external and internal visibility, being cited as reference in social technical assistance by the media, public and private sectors and the increase of students' interest in participating in this extension action.

The actions of NASFE-Educação also present the first results with the municipal school Professor Augusto Gotardelo, where during three alternate days one can carry out playful activities of socioenvironmental awareness with 38 children ranging from 10 to 12 years of age. The visits were accompanied by the pedagogical coordination of the school and counted with the participation of the Minas Gerais State Military and the Municipal Civil Defense Fire Brigade, complementing information on the subject of "Learn to Prevent" and the subtheme "Too much or too little water equals disaster?" In July, a school gymnasium is planned to gather the external partners in an extension action of the Federal University of Juiz de Fora.

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CHAPTER 44

Leadership Skills Development in Undergraduate Students at Out-of-classes' Engineering Projects

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Abstract: Leadership consists of a set of skills and involves a broad behavioral issue, once that it is required many skills of a good leader to present a satisfactory result in relation to the team and to the activities proposed to the group. It is necessary to understand that all the attitudes of a leader are resignified and interpreted in different ways by all the people involved in the group, since what is spoken can be misunderstood or partially understood, embarking on a matter of communication. Therefore, there is a great need for a leader to have a well-grounded speech and to follow a line of logical reasoning or to stay in line with the firm's or work group's convictions. Also, it is required a good knowledge of the process that the group deals with, beyond management strategies and methods. In this paper, will be discussed the experience of some undergraduate Engineering students that are leaders of extracurricular projects at the Pontifícia Universidade Católica de Minas Gerais - Campus Coração Eucarístico in Belo Horizonte, Minas Gerais. Each project has its own peculiarity and so, it requires the experiences of different leaders. It is significant to realize that, currently, those who do not seek this type of experience do not live the full experience of what the University has to offer as a teaching, research and extension space. In this way, the students profile are not fully developed when they only experience the traditional education, in the classroom, especially when it is considered the possibility of improving leadership skills. There are few topics in the curricula of Engineering courses that really deal

with entrepreneurship, business and people management, so it is interesting to realize the space of extracurricular projects for the development of these skills and the promotion of a contact space between University - Market - Society. To evaluate the experience of the leaders were developed questionnaires, applied to the leaders themselves, the group members and the counselors responsible for those students. In addition, in meetings, relevant guidelines are taken with the meaning of discuss and share problems and results, promoting an exchange of information between different groups. With each experience it is possible to realize that there is a profitable knowledge, so, for common problems solutions are proposed. Another point is the success that each group presents in their own proposals, revealing that each leader does a successful job. With this study, it is possible to perceive the University's effectiveness in developing leaders and promoting opportunities to work on extra-class projects where these skills and competencies are improved. This is of extreme benefit to society and the labor market, since these people have acted alongside these segments, which demand people with different skills. For the students, the possibility to develop themselves as leaders, still during their graduation courses is very pertinent because it allows the experience in professional, scientific and technological projects, besides improving their personal and professional spheres.

Keywords: Competences, Engineering Education, Leadership, Out-of-classes'

Projects, University.

44.1 Background

According to Bennis & Nanus (1985), leadership is related to having vision about what to do, paying attention to everything that is happening, establishing a new direction, and, above all, maintaining the focus of everyone in the organization [1]. Therefore, a leader needs to be good at planning, organizing, commanding, and controlling, to make the employees achieve what most people deem impossible.

The profile of a leader arises from the will to see something happen, be it from ambition to success or from the achievement of goals objectively created for the project, leadership ability is formed around a personal purpose to achieve a goal. However, to lead a team of people there is to preserve a number of personal skills in pursuit of being as comprehensive as possible.

Considering that leading a project involves a variety of other issues, including leading people, the leader must develop emotional intelligence characteristics that make him/her empathic, charismatic, considerate, able to understand the profiles of his or her team, to preserve otherness in relationships to direct it and motivate it in the best way.

The personal conduct of each leader translates how respected he is by his team, creating his own visual identity within the work environment, and developing skills such as the ability to listen to everyone and work while keeping the team motivated. According to Hersey (2012), the leader is seen by the way he behaves, further evidencing his own identity [2].

Persistence, if not the highest quality in leadership, must be dominant in the leader to pursue the goals, as well as be as an example to others.

Another important point of a leader is his flexibility, being able to innovate and change. The lack of success, according to Charan (2012), may be due to the reluctance to continue exercising the same activities that have already yielded success [3].

Thus, the present article aims at the exchange of leadership experiences in various extracurricular works at the University, covering all the difficulties encountered, as well as, positive points of each experience, allowing the student to have access to a specific knowledge creating the opportunity to develop as leader without the need for prior knowledge of the subject, but developing their own leadership identity.

44.2 Purpose/Hypothesis

When the topic of leadership in undergraduate courses is approached, this concept is usually linked to curriculum subjects, however, through extraclass academic projects in the context of Engineering it is possible to perceive the effectiveness of a leader's development [4-5]. The interesting thing to notice is that often the experience of leadership is only experienced when the students goes to the job market, however with these projects it is possible to realize that they can acquire this set of skills still in the undergraduate course.

Therefore, in the context of Engineering Education these projects have much to contribute to the formation of a more qualified professional, and that has adequate competences to the Labor Market. Another point favorable to the participation of undergraduates in this type of experience is that it increases their engagement with the University, favoring the relationship the students have with each other, such as with the teachers, with the technical-administrative body of the University and with the public, external of the academic community.

A University that forms effective leaders is more likely to stand out among private companies, other higher education institutions and in regional scales. These leaders, who are empowered inside of the University, when will work professionally will be more likely to be good leaders, since they already have that knowledge.

This paper analyzes how is being the development of these leaders and how they realize that some skills have been gained through these experiences. For this study, five extraclassed academic projects were analyzed in the context of

Engineering within the Polytechnic Institute of PUC Minas (IPUC): Extension Project “Engineering in School”, Extension Project “Arduino for Children and Teenargers: Rising Interest in Exact Sciences and Technology”, “IPROJr” Junior Company, “Engemech Baja” Team and “Flying Priest Aerodesign” Team.

44.3 Design/Method

In order to identify the main competencies of the leaders of each project, a form was prepared to measure the skills demanded and those developed with their experiences. The key indicators for a leader have been elaborated, according to Bennis & Nannus (1985) reports [1]: organization, communication and planning. The criteria assess the leaders from their own perspective, while their respective group will then evaluate you as the team leader.

44.4 Results

For the analysis of results, it was decided to filter which would be the most relevant for a better exchange of experience between the leaders, and to optimize the leadership in each extracurricular project, helping in the aggregation of knowledge.

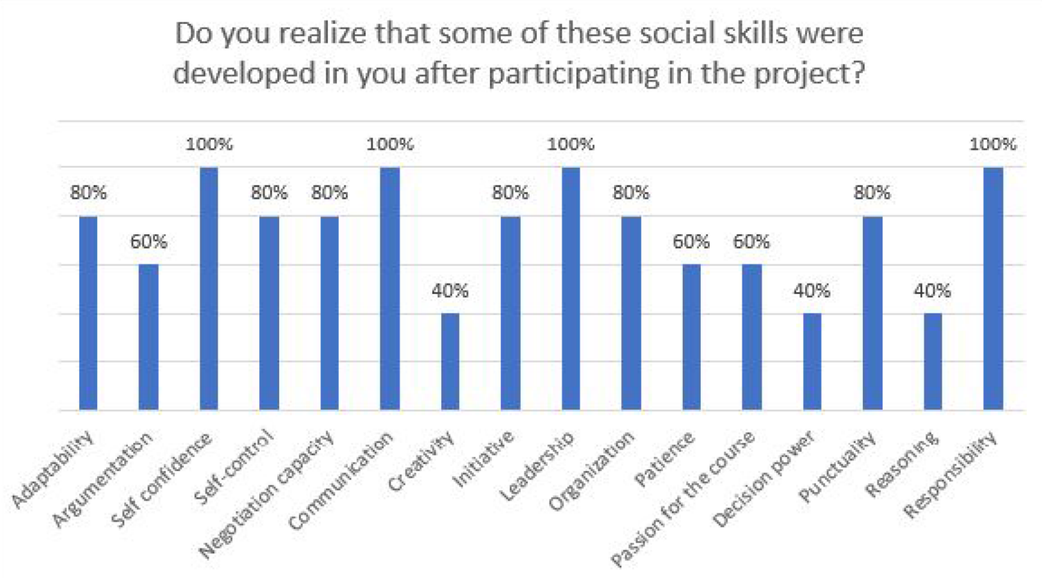

Figure 44.1 – Forms answered by the leaders.

44.5 Conclusion

From the results analyzed, it was possible conclude that each leader developed different skills, but some of them were developed by the majority. In addition, it was possible make an exchange of experiences, helping in the difficulties of each project.

With this study is possible to validate that out-of-classes' projects contribute a lot to the personal development of undergraduate students, being a great opportunities for the work in groups.

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CHAPTER 45

The Importance and Application of Calculus as A Basis for Engineering Knowledge

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Abstract: Working meaningful learning is to create concepts that are perceived by the student in practice. The question guiding this work is how to accomplish

this intent with disciplines involve mathematical tools? To answer the question were created techniques of anticipation of knowledge presenting applications of these tools in systems, circuits or applied calculations of Engineering. For the study presented here, a basic sinusoidal rectification circuit of the Electrical Engineering was used to apply the definite integral concept, calculating the effective voltage obtained from this half wave rectifier. The specific discipline adopted was the Power Electronics and, with this, it was possible to make plausible to the student the practical use of the mathematical tool worked in the discipline of Calculus II.

Keywords: Electrical Engineering, Interdisciplinarity, Learning, Mathematics, Rectifier Circuit.

45.1 Background

Engineering training should be based on a strong application of mathematical tools, to subsidize the professional's decisions on deterministic and auditable criteria. However, the basics disciplines of the Engineering cycle, especially Calculus, often lead students away from the focus of building, applying and performing practical activities for their chosen Engineering. On the other hand, the disciplines of Calculus have wide applicability, which makes possible the most efficient and qualified formation of the logical reasoning and of a professional critical and prepared to face the possible challenges in the field of Engineering.

Pedagogically, it is understood that it is during the initial phase of the course that the mathematical concepts must be studied, related and applied in practical situations, as in the area of Electrical and Electronics. The empiricism involved, many times, ends up being proved only by mathematical calculations [1].

For students acquire logical autonomy, they need to learn meaningfully and not only respond to school assessments. It is verified that Calculus is one of the determining disciplines for the process of formation of the Engineer, being fundamental in the construction of the quality and competence of this professional. In this sense, it is recommended the association of new educational technologies with the disciplines of Calculus, besides a process of reflection on the part of the teachers [2].

45.2 Purpose/ Hypothesis

The interdisciplinarity, more specifically between Calculus II and Power Electronics I, making it possible to show the Mathematics behind a single-phase rectifier circuit from half wave to diode.

Rectification is the name given to the process of transformation of alternating current into direct current or its effective equivalent, that is, the electric voltage that performs effective work on the load. This is one of the processes that allows DC equipment to be fed from the alternating current offered by the power grid. Half-wave rectification allows the use of only one half-cycle of the input voltage of the load and is used in equipment that does not require pure continuous voltage, such as battery chargers, for example [3].

45.3 Method

For attract new pedagogical paradigms in the teaching of Calculus for Engineering was realized in the discipline of Calculus II, the instigation to the research and application of the concepts studied in relation to the specific course of each student. In this case, we are referring the analysis of a simple circuit with an alternating source, a diode and a resistive load, Figure 45.1.

With the concepts of defined trigonometric integral, the voltage in the load was calculated, using as a limit the coordinates of a half-cycle, ranging from 0 to π radians, in a given period of 0 to 2π radians, where the equation comprises [3]:

$$V_{Lmed} = \frac{1}{2\pi}\int_0^{\pi}\sqrt{2}V_0 sen(wt)d(wt), \tag{1}$$

where w is the angular velocity and V_0 is the peak voltage.

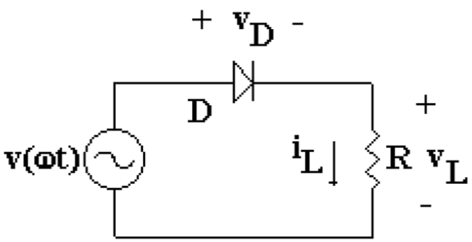

Figure 45.1 – Half-wave rectifier circuit [3].

45.4 Results

Through the interdisciplinary action it was possible to note the importance of the applicability of the mathematical concepts in the conversion of electric energy, arousing the interest to explore more and more the connection between disciplines, generating a lasting learning. Besides, the students are instigated to seek to extend their knowledge with their specific Engineering, expanding their bond with it from the beginning of the Course chosen [4].

45.5 Conclusion

In addition, when studying the discipline of knowledge application, the theoretical background will facilitate learning, allowing a greater development of the knowledge acquired in it, strengthening the trained professional.

The proposal of this study is still new, with two years of activity, and that is why was represented only as an expanded abstract, portraying some of the resources and tools used to instigate learning. In the future, the actions will be expanded and the results validated based on qualitative and quantitative.

Until now, the contextualization with later experiences has been positive, forcing the student to seek new references with more advanced colleagues and Teachers in their specific area of Engineering.

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CHAPTER 46

Analysis of The Characteristics About The Face-to-face and Distance Education that Contribute to Technical Graduation in Electronics Science

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Abstract: In Brazil, according to Law n.9394 from 1996 the formal education is offered in two modalities: one is the Face-to-face Teaching and the other is the Distance Teaching. The first modality is conventional teaching and learning, that is, one that happens through direct communication between teacher and student within a classroom. According to current legislation and institutional norms, the Face-to-face Teaching requires a minimum percentage of 75% attendance to teaching activities and mandatory presence at the assessments. On the other hand, the second modality began to gain more attention in proportion to the evolution of communication technologies. Formally inserted in the educational context since the last century, the Distance Teaching is characterized by the physical separation between teacher and student. One of the great challenges is to replace Face-to-face Teaching with Distance Teaching without losing quality. In Human Sciences areas, for example, the Distance Teaching courses may adapt easily due to the focus of academic education.

However, in technological courses such as Electronics, the student needs a more effective interaction with the practice conducting experiments and tests. Thus, it is necessary methods and procedures that students need to keep the level of quality between these two modalities. The objective of this work is to analyze the positive and negative aspects of technical courses in the area of Electronics in Face-to-face Teaching and Distance Teaching in different educational institutions and to identify what leads students to adopt one or another modality. The research results show that the Face-to-face Teaching courses have a great advantage in relation to the Distance Teaching courses, being this the possibility of the student to do practical classes with the presence of a teacher. The main advantage of Distance Teaching is that the student has more flexibility in scheduling. Also, it was verified that of the five institutions researched two offer face-to-face courses and four offer distance courses. We propose a discussion about the challenges and initiatives for keep the quality of education for both modalities.

Keywords: E-learning, Distance and Flexible Education, Face-to-face Teaching, Distance Teaching, Tool Education.

46.1 Background

In the last year, due to changes in the Law of Guidelines and Bases of National Education (LDBEN) [1], a great increase of the technical courses and superior courses of Distance Teaching was allowed. The emergence of technical courses in the area of Electronics has brought to the fore questions regarding the quality of the course in Distance Teaching. This is due to the inevitable comparison with the Face-to-face Teaching, which in turn, is characterized by the development of the student in practical classes. Being used diverse materials, such as manipulation of instruments, development of circuits and electronic projects in the practice [2]. Professionals in Electronics, students and companies have been impacted by constant technological innovations as well as changes in the world of work that require ever more complex professional profiles. The new communication technologies are important allies in the offer of distance courses aimed at professional qualification. Despite the importance of Distance Teaching in qualification for work, there are few studies on the results of practical educational events offered in this modality of teaching.

46.2 Purpose/Hypothesis

In Brazil, there are some courses in the modality of Distance Teaching that give right to the registration of Regional Council of Engineering and Agronomy

(CREA) [3], but this registration is restricted, that is, the attributions of the professional graduate in Distance Teaching are limited. This professional becomes a Technical Assistant and not a Full Technician, not being able to sign or execute projects among other things. According to the normative decision n.70 of the Federal Council of Engineering and Agronomy (CONFEA) [4], only Full Technicians in Electronics and Electrotechnology can carry out activities of design, installation and electrical maintenance. Research released in 2010 revealed that, contrary to what is imagined, the impact on employment and the salary of those who attended technical education is equal in the modalities of Face-to-face Teaching and Distance Teaching.

46.3 Design/Method

Our methodology is based on research carried out in five educational institutions in the city of Curitiba and metropolitan region, namely: Monitor Institute, National Industrial Learning Service (SENAI), Educational Society of Santa Catarina (UNISOCIESC), Federal Technological University of Paraná (UTFPR) and Polytechnic School of the Pontifical Catholic University of Paraná (PUCPR). This research covers technical courses in the area of Electronics offered in Face-to-face Teaching and Distance Teaching modalities. The first objective of the research was to compare information related to the course, such as course load, disciplines, laboratories, simulation tools, mandatory internship and student assessment. Another part of the research consists of a questionnaire applied to students of educational institutions, containing questions related to the two teaching modalities were approached. The next section presents the results.

46.4 Results

From the information collected, it was verified that in the Distance Teaching courses, students undergo the classes through an educational platform with videotapes and download of the didactic material, using tools of interaction with teachers and other students. Additionally, the practical classes are done through compulsory internship in a company of the area, and the assessments of the student is made at the end of the course by means of a theoretical test. In the Face-to-face Teaching courses, students have theoretical classes at the institution, together with practical classes for each applied discipline, being developed in laboratories. Teachers evaluate and clear the student's questions in the classroom and assessments are made in certain periods applied by the teacher. In addition, it was verified that not all educational institutions in the Face-to-face Teaching require compulsory internship. The following, we present same responses as a percentage of the questionnaire. The total number of samples was 104 students of the courses in the area of Electronics in the modalities of Face-to-face Teaching and Distance Teaching. Through the results, it is observed that the technical courses offered in the Distance Teaching lack practical classes, which reflects in the students' uncertainty regarding theoretical content seen during the course. It has also been found that even if there is compulsory training in the area or the use of simulators, the practical class is indispensable for the technical training of the student. In addition, students believe that taking hands-on classes could allow for a better placement during a job interview. It can be highlighted that the main advantages of Distance Teaching are the flexibility of schedules, followed by reduced costs with tuition and travel, as well as ease of access to course content.

1. Do you believe that the modality of Distance Teaching works for all areas? For example, is it possible to imagine a distance graduation for technical courses in Electronics? Yes - 40.4 %, No - 34.6 %, Maybe - 25 %.

2. Do you agree that time savings with travel can also be considered a great advantage for those who choose distance learning courses? Yes - 78.8 %, No - 9.6 %, Maybe - 11.5 %.

3. Would the experimental practice in laboratories for technical courses such as electronics be dispensable when doing a mandatory internship? Yes - 9.6 %, No - 75 %, Maybe - 15.4 %.

4. Some Distance Teaching courses provide simulators for the student to con-

duct experiments, do you believe that these simulators would be enough to learn courses in the technical modality? Yes - 19.2 %, No - 61.5 %, Maybe - 19.2 %.

5. One of the advantages of the practical classes is the effective possibility of the student being able to put the hand in the mass and to see the operation of the experiments in the practical one, then it could be said that it would be obligatory practical lesson for the formation of a technician in electronics? Yes - 98.1 %, No - 1.9 %, Maybe - 0 %.

6. If you are asked to do a practical job interview question, would you feel confident to do it even if you have not had practical contact in a Distance Teaching course? Yes - 9.6 %, No - 69.2 %, Maybe - 21.2 %.

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CHAPTER 47

Development of An Educational Application to Aid in The Learning of Photovoltaic Systems

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Abstract: Education, over the last few years, has undergone several changes due to the evolution of technologies and communication. The continuous growth of technology has contributed to improving the lives of people and especially access to information, and it is possible to expand tools favorable to the progress of education. Currently, one of the main topics has been an education for sustainable development with the aim of highlighting the importance of sustainability for environmental preservation. With the increasing consumption of electric power in the world, the incentive to sustainable energy sources has grown considerably in the last years and the demand of alternative

energy sources that integrate to the network presents an accelerated growth in both urban areas and in rural areas. Solar energy, in particular, has practicality, versatility, and modularity of installation, being a simple or complex system. In addition, even if project design is an important step, there is still a lack of access to information and its installation. In the educational analysis, there are disciplines that require the student's dedication and practice for their understanding, and there is a need for alternative methods that help in the understanding of practical and theoretical knowledge acquired in the classroom applied to the labor market, integrating them with an easy access, making this learning more effective. In this way, the proposed article presents an application that dynamically aims to teach the theory and the design of photovoltaic projects (solar panels, batteries, inverters) of on-grid and off-grid systems. Expanding knowledge and access to information for field professionals, students, and even consumers through the Solaris application, which integrates solar radiation database and equipment information, capable of providing quick references, tips and also project size. Developed for the Android mobile device system, the application is accessible to Engineering students by providing theoretical introductions, calculation methods and guides for system installation from the user's location by reporting the average local irradiance, optimal installation angle, estimation the production of energy, the number of photovoltaic modules, the capacity of the bank of batteries and the design of inverters, collaborating in the process of teaching and learning the main factors that determine the generation and efficiency of the photovoltaic system.

Keywords: Educational Applications, Mobile Learning, Sustainability, Photovoltaic System.

47.1 Background

The expansion of the participation of solar energy demands the improvement of scientific methods and consequently of teaching, so that the knowledge, planning and control of energy systems is taken into account the environmental conditions characteristic of the place. An increasing number of small and medium-sized (but highly innovative) companies and research institutions already address this new field of study and services in several countries, mainly in Europe. The availability and variability of the solar energy resource are intrinsically associated with the conditions of the region [1-2].

The use of Android, a mobile operating system with more than one billion active users per month, makes the ecosystem conducive to application development. With this focus, the applicability of study integration was analyzed to an easy-to-use interface that can show information with practicality and offering the mobility of the smartphone.

47.2 Hypothesis

Through research on the current scenario of generation from solar energy, it was identified the importance of GD (distributed generation) as one of the factors of change of the global energy structure, from a unidirectional and centralized system to a dynamic bidirectional and decentralized system. Considering this, the photovoltaic systems present great capacity of use in several countries, for example in Brazil. In view of the great applicability of these systems and in order to make possible a complementary teaching method on solar energy and photovoltaic systems, the Solaris application was developed.

47.3 Method

Aiming at a practical and reliable source, both an academic and a professional approach were applied, in this way one can divide the functionalities according to Table 50.1.

The first module, Projects, aims to instruct the user by first presenting the choice of the installation site by means of an interactive map, then allows the user to enter the necessary data for the system sizing. After this step, the respective parameters are calculated.

Table 47.1 – Application features.

Modules	Description
Projects	-Choosing the location of the PV system deployment; -Acquisition of consumption data; -Calculation of parameters (power, number of modules, inverter design).
Equipments (under development)	- Database: batteries, on-grid and off-grid inverter, solar panels approved by INMETRO[2].

47.4 Results

Through research and development of the application we aggregated the main topics to determine the sizing of PV systems, demonstrating that it can be utilized as a tool. The data provided by the application is showed efficient comparing to the manual method. Figure 47.1 summarizes the application workflow.

47.5 Conclusion

The efficient use of solar energy must be achieved through educational policies aimed at introducing the technical aspects of the photovoltaic system. The dimensioning of a photovoltaic system should be debated and concretized

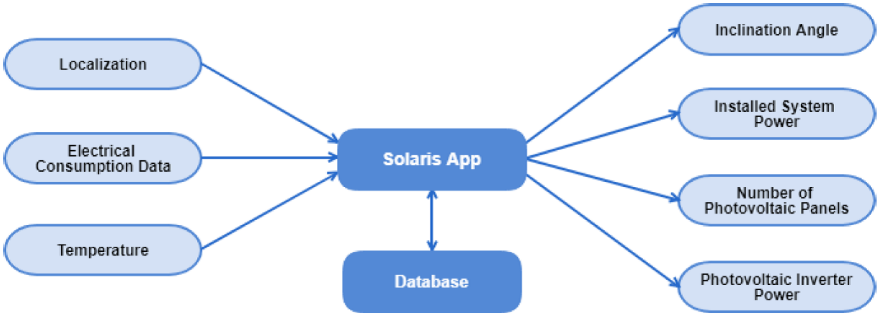

Figure 47.1 – Unesp Racing's 2017 prototype.

in the educational environment to foster initiatives that transcend this environment, reaching the neighborhood, the municipality. Through environmental education, there is the democratization of environmental information, influencing and strengthening a critical awareness about the environmental problems of the impacts generated by the excessive use of non-renewable natural resources as a source of energy.

Environmental education with an emphasis on renewable energy generation needs to be increasingly discussed in the educational environment, the proposal of the program developed in the Android platform aims at the digital interaction with the student, improving their learning, as well as teaching the design of the photovoltaic system, highlight important information about this sustainable source.

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CHAPTER 48

Photovoltaic Solar Cooperative: Solidary Economy as A Basis for Social Development

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Abstract: The advent of photovoltaic energy, Brazil's geo-climatic favoring of solar radiation levels and adequate temperature, social inequality followed by high levels of unemployment and the regulation of distributed generation with compensation system, motivated the elaboration of a business model based on a platform focused on the social development of communities through access to electricity. The project is essentially based on the composition of cooperatives, stakeholder grouping, creation and assembly of photovoltaic plants, distributed generation of energy and compensation of credits for the

members. The agents involved, their desires, needs, discomforts, functions in the process and the connections with other agents are described. Primarily, the model is composed of investors, beneficiaries, volunteer professionals, benefactors, the cooperative and the energy utility. Investors will receive shares that qualify their participation. The beneficiaries' packages will be distributed by the cooperative, so that they fit the reality of these participants. With the implementation of the cooperative, the focus will be the assembly of the photovoltaic plant, to accomplish the schedule and the defined proposals. It is also proposed an online platform for the integration between the agents, with relevant information, a communication channel to solve doubts or requests and questionnaires that will be used in the continuous improvement of the model. Finally, the gains for all involved and the social impact of this action were evaluated. The degree of satisfaction can be measured through questionnaires available on the integration platform. This work was developed through the realization of workshops and the application of the methodology of Design Thinking. The workshops have counted with the participation of the designers of the project. There were divergences of thought, discussion, and shifting of opinions at each meeting. Thus the project was gradually built. The method used in the process is a disruptive learning tool, which escapes the traditional teaching model, encourages graphic thinking, requires group dynamics, creativity with active participation, exercises visual memory and organizes thinking for visualization of solutions. The success of the tool was expressive, including naming the business model as "Islands of Light".

Keywords: Active Learning, Photovoltaic Cooperatives, Social Development, Solidarity Economy, Thinking Design.

48.1 Background

According to the Ministry of Mines and Energy of Brazil [1], the Brazilian energy matrix is mostly hydraulic, being this source responsible for more than 60% of the energy generated in the country. Annually this portion has decreased due to business viability with alternative sources. Among these, stands out the Solar Photovoltaic Energy, with great potential of generation in Brazil.

Photovoltaic energy is one of the most widely used sources in the world, renewable, sustainable, presented as an alternative to traditional sources and produces less impact on the environment compared to hydroelectric, thermoelectric and nuclear energy.

Despite all the advantages of photovoltaic energy, this technology is not available to all people. This is mainly due to the lack of financial resources to acquire the system and the lack of knowledge about the regulation of this type of energy.

One possibility to change this scenario is in Normative Resolutions Nº 482 [2] and Nº 687 [3] of Agência Nacional de Energia Elétrica (ANEEL) that bring in their texts the possibility of distributed and shared generation through cooperatives. In this way it is possible for a group of people to benefit from the energy credits generated by a remote photovoltaic plant, as long as they are all within the concession area of the energy utility. In the case of cooperatives, there is a requirement of a minimum of 20 individuals for training [4].

Currently, Brazil suffers from high levels of unemployment, social inequality and precariousness in the health services and basic education of the public network, and the portion of the population most affected makes up classes D and E. In this scenario, actions from the private sector are very welcome and, almost always, necessary. These actions are not always linked to money or products of everyday use, they may include access to activities, culture, art, etc. Here we will deal with the electric energy service, essential to the human being and that can provide access to better conditions of hygiene, health, electricity, education with Internet, among innumerable benefits for the quality of life.

48.2 Purpose/Hypothesis

The high level of solar radiation in the Brazilian territory, the possibilities created by ANEEL resolutions Nº 482 and Nº 687, the constant study of business models, and the indisputable need to improve the access of the population of the D and E classes to electric power motivated the proposition of a business model for the creation of photovoltaic cooperatives focused on the creative and solidarity economy.

According McKinney [5], the basic idea behind the creative economy is simple: The most important skill is now no longer simply having knowledge, but demonstrating the ability to use that knowledge to come up with new and great ideas.

48.3 Method

The business model was developed from weekly group meetings. Design Thinking techniques were applied at these meetings. According to Thomas [6], Design Thinking is essentially a human-centered process of innovation that emphasizes observation, collaboration, rapid learning, brainstorming, rapid prototyping of concepts and simultaneous business analysis, which ultimately influences innovation and business strategy. The term “Design Thinking” is usually called applying the sensitivity and methods of a designer to solving problems regardless of the problem.

Thus, during the meetings, service, empathy, conceptual maps and other graphic elements were elaborated with the purpose of organizing the ideas, concepts and information to formulate the model. There was also a lot of interaction among the participants in the working group. Analyzes were carried out and several innovative ideas and creative solutions were presented for the composition of the business model [7]. Figure 48.1 and 48.2 shows two of the products produced during the meetings.

In these meetings it was possible to identify and characterize each of the agents that make up the business model, to detail the operation of the agent integration platform and to estimate some technical requirements of the photovoltaic plant.

48.4 Results

From the investigations carried out in a group, it was verified that the agents involved in the process are the investors, professionals in the area of photovoltaic energy, benefactors, the energy utility and the beneficiaries of the generated energy. All these will constitute a cooperative. The cooperative is the basis of the business model and is responsible for interconnecting the agents.

The beneficiaries are people with low socioeconomic status, who compose peripheral communities of the city and have restrictions on the benefits offered by electric energy, such as internet access, radio, light, TV, refrigeration, etc. It was identified that these people are not aware of the benefits of photovoltaic

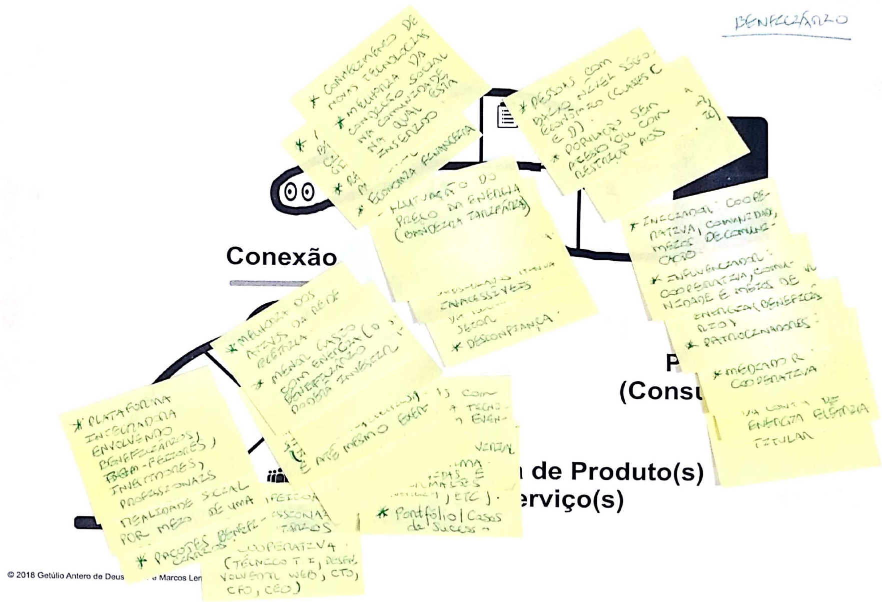

Figure 48.1 – Map of Products and Services.

technology and neither are conditions of access to it. It was realized that these people want a better social condition in the community in which they are inserted and have access to the benefits offered by electric energy. It was also identified the interest in knowing new technologies.

Investors are private companies or people who have better financial conditions and an interest in helping underprivileged communities. Its participation in the business model will be with the financing of the equipment of the photovoltaic plant. Although they do not receive something in return these compa-

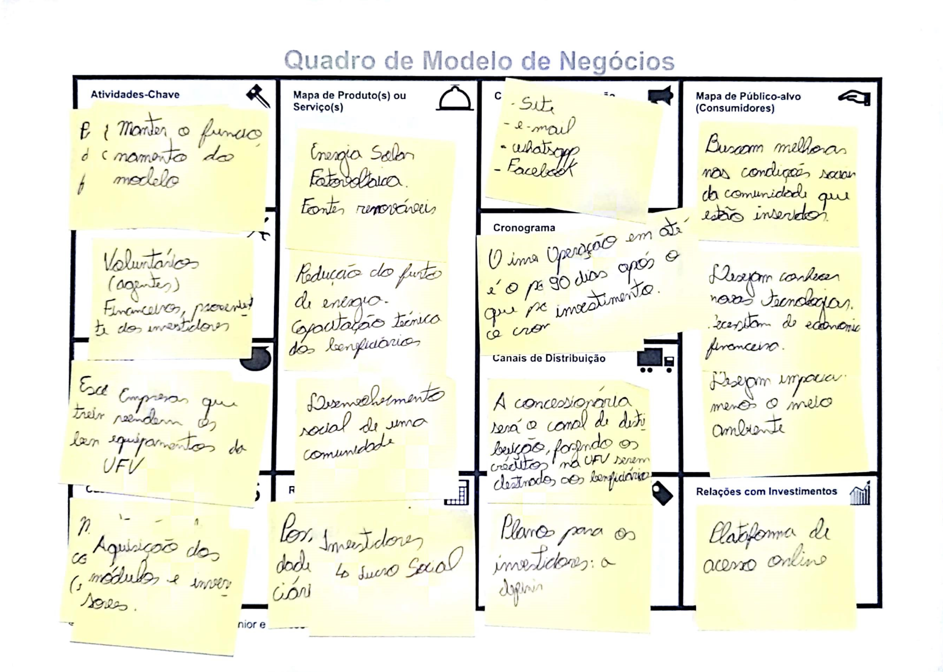

Figure 48.2 – Business Model Framework[8].

nies and people wish to be recognized for their actions and for their incentive to use renewable and alternative energy sources. They aim to demonstrate that they have social and environmental awareness.

Photovoltaic professionals are volunteers who contribute to the installation process of the photovoltaic plant. The contributions can be given in the stages of elaboration of the project of the plant, in the execution of the work and in the homologation of the system with the electric energy utility. It was observed that these professionals wish to have experience in their areas and put into practice the knowledge acquired during their training.

The benefactors are the people who give some space for the assembly of the photovoltaic plant. These spaces can be carved from their homes. Thus, they may receive a percentage of the credits generated, as an incentive.

The utility that supplies the community is responsible for receiving the electricity generated at the photovoltaic plant and for distributing it in the form of credits to the beneficiaries.

Although each agent possesses experiences, socioeconomic profile, different desires and needs, the business model should be advantageous for all members and focus on changing the social reality of a community. It is also verified that the sustainability of the model is only possible with dedication, volunteering, donation, serious work and involvement of each member [9].

The integration platform is another fundamental element of the proposed model. It is an online system where agents can get informed, ask questions, know who the others are involved in the process and share their experiences in the business model.

As for the photovoltaic power plant, the power installed by the insolation method was estimated [10]. The mean daily sunshine (Wh/m^2/day) of the selected region was obtained using the Cresesb SunData tool [11]. In the design stage this calculation must be improved and take into account other variables, such as the azimuth, catalog characteristics of the modules and the sizing factor of the inverter. It was calculated that the photovoltaic power plant should generate an average of 2.000 kWh per month, in order to serve thirty beneficiaries. Sixteen of these will receive 50 kWh, eight 75 kWh, four 95 kWh and two 110 kWh. In this way, installed power to generate the desired energy in the city of Goiânia should be approximately 13 kWp.

48.5 Conclusion

This model is what makes all the agents that are benefited, even if in different ways. See also if the business model has been updated for social development and for the preservation of the environment. The model is presented as a way to encourage companies to invest in social programs and contribute to building a better world.

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CHAPTER 49

A Course of Leveling Exact Sciences: A Way of Reducing Rates of Evasion and Improvement of Higher Education Analysis of The Performance of A Calculus Class Between Leveling-

course Students and Non-leveling Course Students

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Abstract: Several studies on the performance of Engineering students in Brazilian higher education indicate that one of the major problems faced by these and by educational institutions is the high levels of evasion and failure in the first two years of the student at University. There is an extensive literature that points out the relationship between the phenomenon described above and the high deficiencies that the new entrants have in their formation of exact sciences when entering higher education. This scenario is reflected at Universidade Federal do Pará (UFPA), since the indicators of disapproval in the basic disciplines of the undergraduate courses in Engineering of the Instituto de Tecnologia (ITEC) overcome 50%. In order to mitigate this problem at UFPA, the Program of Learning Leveling Courses (PCNA, acronym in portuguese) was implemented in 2011, which is one of the main pedagogical strategies to teach Elementary Physics, Chemistry and Mathematics during three weeks, for ITEC Engineering freshmen (their priority public), as well as for students from other UFPA courses and campuses, before the actual start of the universitary term. Other publications by PCNA, had already indicated improvements in the approval of PCNA Cursists (students who completed the Leveling Course about Elementary Mathematics before the discipline of calculus) in the initial discipline of Calculus. This work, however, counts on the standardization of the form of evaluation of the same students, both in Calculus and in the PCNA, to determine the direct impact of the PCNA as a mechanism to combat against evasion, evaluating not only the approval, but also the academic performance of the Cursists in relation to the Non-Cursists (students who did not participate or did not complete the referred Leveling Course). When comparing the data of 553 Engineering students, were found that: among the 39% approved in the subject, about 70% were Cursists. About 20% of these obtained the maximum concept, against only 3% for the Non-Cursists. The evasion rate was 6% for the Cursists, against 63% of the Non-Cursists. Change in approval for the Cursists was greater than 95%. In this way, it is worth highlighting the positive impact that The PCNA had on the academic performance of its students, contributing to reduce the rates of evasion of the Engineering courses and leveling the knowledge among the Engineering classes entering the UFPA. The relation between the students participation in the PCNA, their concepts and their approval in the discipline becomes evident.

Keywords: Calculus Teaching, Engineering Education, Evasion, Higher Education, Leveling Course.

49.1 Background

Although Calculus is one of the most important basic disciplines in exact science graduations, it causes fear in newly enrolled students in higher education, especially in Engineering courses. This situation results in high failure rates, where, only at Instituto de Tecnologia (ITEC) of Universidade Federal do Pará (UFPA), these figures exceed about 50% [1].

According to available literature, it is possible to affirm that the cause of this problem is the quality of mathematics teaching in elementar, middle and high schools [2-3], in addition to the fact that the student prefers the method of answering rather than linking to conceptual ideas [4].

In order to reverse this situation, UFPA created, in 2011, the Program of Learning Leveling Courses (PCNA). This Program consists of teaching mathematics, chemistry, and physics classes, by veteran Engineering students, for three weeks; facilitating the interaction of student-monitor, which awakens the conviviality between veterans and freshmen at University, besides favoring the teaching-learning activities offered by PCNA [5].

49.2 Purpose

This paper aims to analyze the influence of a level course of elementary mathematics of the PCNA on the academic performance of the Engineering entrants in Calculus I; particularly regarding the criteria of avoidance and approval in the discipline, whereas the concepts of evaluation obtained by the students.

49.3 Method

The data in this work come from the academic concepts of 553 Engineering students enrolled in Calculus 1 in the UFPA in the first half of 2017 and internal control of the PCNA.

The students who completed the leveling course were later classified as Cursists, while the remaining students, those who did not participate or did not complete the Program with a minimum frequency of 70%, were classified as Non-Cursists.

The percentage adhesion of each Engineering represents the ratio between the number of Cursists in the class and the total number of students enrolled, and the percentage of total approval, indicates the ratio between the number of students approved in the discipline of Calculus and the total number of students, and the PCNA-Cursists approval percentage is the ratio of the number of Cursors approved by the total number of Cursists enrolled.

The Percent Change (%) of approval was obtained as the ratio of the difference between the percentages of approval of the Cursists and of total approval of the class by the total of approvals in the class. It can be understood as the value at which the total approval must increase to obtain the approval of the Cursists.

The second analysis consists of the percentage comparison of the concepts of Cursists and Non-Cursists, to evaluate the performance criteria in the discipline and avoidance. It is considered that the performance of the students is directly linked to the concept obtained in the discipline, while the student in evasion situation is the one that did not have minimum frequency to be approved.

49.4 Results

Analyzing adhesion, it is observed that the average number of Cursists in the class is 30 for 7 of the 9 Engineering, reaching 47% in the group of Biomedical Engineering. Exceptions were Computer Engineering (12%) and Telecommunications Engineering (16%), since these courses have two annual entries, and half of the Cursists were only enrolled in the second half of 2017.

It should be emphasized here the classes of Civil Engineering, where the approval of the Cursists was 100 and Food Engineering, which in the class obtained the lowest approval of the analyzed Engineering, both in absolute percentage (10%) and of the Cursists (33%). Despite this, it is noted that 100%

of those approved in the latter class were Cursists.

The calculation of Change in Approval points to a positive change of over 70% for 8 of the nine Engineering classes analyzed, with the exception of the Naval Engineering class, with only 27%. In an analysis of all students enrolled this index is 95

It was observed that 20% of the Cursists obtained the maximum concept in the discipline (Excellent), whereas of the Non-Cursists, only 3% succeeded. A greater difference is noticed in the second best concept (Good), obtained by 26% of the Cursistas and by only 8% of the Non-Cursists.

The evasion analysis revealed that 44% of all students surveyed evaded Calculus 1 course. However, this figure is only 6% for Cursors, and 61% for Non-Cursors.

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CHAPTER 50

Group of Studies in Energy Efficiency: An Action to Raise Awareness about The Use of Energy

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Abstract: The Energy Efficiency Studies Group of Universidade Regional do Noroeste do Estado do Rio Grande do Sul (Unijuí), made by Professors and students of the Electrical Engineering Course, aims to present concepts and knowledge that can easily be converted into Energy Efficiency actions, reinforcing sustainable awareness of subjects who are increasingly capable of being conscious multipliers in the community. The methodology adopted by the study group will be based on statistical surveys, being carried out bibliographical

researches, calculations necessary for the study, simulations in computational environment to anticipate and prove results, aiming the elaboration of an interactive model to present concepts of Energy Efficiency. The entire process of data collection is documented and is discussed among group members. The group uses the Energy Efficiency as a study object to introduce the concepts in speeches and other types of actions with the local community, aiming to bring knowledge inside the student's homes so that they can be applied, contributing to the reduction of the use of electric energy and consequently to preserve the environment.

Keywords: Awareness, Electrical Engineering, Engineering Education, Energy Efficiency, Studies Group.

50.1 Background

The rational use of electric energy is the main premise of an action to energy efficiency. Therefore, the development of an ecologically responsible conscience in young people can transform them into important multipliers in their homes and places of coexistence. However, for this to be possible, this knowledge needs to be transmitted dynamically, through interactive lectures, for example. In order to stimulate interest and, above all, generate reflexive comments that will serve as a basis for the rational use of energy culture. With this, this article has as objective relate the activities developed by the Energy Efficiency Studies Group, of the Electrical Engineering of Unijuí Campus Santa Rosa. Beside academic activities, involving the contents, the group's proposal will also be to carry out activities in the region's schools. This way, it will be possible to enhance the course and institution actions along with the awareness of energy consumption, reinforcing the commitment to the community.

50.2 Hypothesis

Energy Efficiency is an activity that have the objective to improve the use of energy source. Is defined by the relation between the quantity of energy used to realize some activity and the available quantity of energy used to your achievement, applying it in an effective and rational way [1].

50.3 Method

The methodology adopted by the study group was based on statistical and technical surveys to meet the following hypotheses: theoretical activities: bibliographic research to find the necessary data; theoretical/practical activities: calculations required for the studies; simulations in computational environment - anticipating and proving the practical results in order to obtain the interactive model project; reports and documentation - formalizing the activities and generating data to create articles and documents related to the studies; publications: recording the conclusions and presenting the data analyzed. For the development of the project, the study group worked with the following structuring contents: Electric Circuits; Microprocessors; Electrical Installations; Electric Power Generation; Power Quality; Among others.

50.4 Results

As the first activity, it was suggested that each student in the group carry out the survey in their family home, detailing the equipment, its respective nominal power, daily and monthly usage time, total residence consumption and the number of people belonging to the group family. Then, a table was constructed to compute the information, in order to obtain the values referring to the time that each apparatus is connected. We used the values according to the time of use of each user, compared to the actual monthly consumption of each residence, the study was carried out with 12 students, having as consumption reference the month of April of 2018.

In order to find per capita consumption, the data referring to the total household consumption divided by the number of people belonging to the family group were used. From the individual per capita value, the average of the group is calculated and then compared with data provided by the EPE [2], thus making a comparison with the average per capita state and national consumption.

As the research was developed with a sample of 12 consumer units, geographically located in a region with thermal amplitudes, hot summer and cold winter, which makes the homes are equipped with electrical devices for the different seasons of the year. Thus, daily comfort directly reflects the increase in per capita consumption in relation to regions where there is little thermal variation. Of the largest consumers that are air conditioners, shower and freezer/refrigerator, totaled 57.45% of the total/average consumption (100%) and the other 42.55% were divided into kitchen, laundry, lighting and entertainment.

Do more with less, reduce energy consumption by providing the same level of service, this is the goal of energy efficiency study. Adopting efficient equipment in homes, despite having a higher initial cost, is a way to increase efficiency, since it will be paid in the long term.

One of the most classic examples when it comes to residential energy efficiency is lighting. Responsible for about 21% of the electric energy consumption in a residence, the type of lamps used strongly impacts the consumption of kWh and, consequently, the costs [3]. Currently, there are 3 types of bulbs more commercialized: incandescent, compact fluorescent and LED (Light

Emitting Diode). According to Jarczeski et al. (2018), the comparison between the consumption of an LED lamp and an incandescent of the same luminosity is twelve times smaller [2].

Since 1984, with the implementation of national plans for energy efficiency in all sectors, by the year 2003, about 42.5 TWh have been saved in the final efficient use of energy, equivalent to 11.8% of demand for electricity in the year 2005. Looking specifically at the residential sector, it represents about 10% of the estimated energy efficiency potential, which would result in the approximate value of 7.5 TWh of electricity savings.

The design of an interactive residence model was developed to intuitively show the electric energy expenditure in kWh by equipment through a drive system, which simulates home appliances within a residence, showing in real time the expenditure of each equipment. However, despite the students' effort to develop the model, it can not be completed. In this sense, the project will be integrated with other UNIJUÍ projects.

50.5 Conclusion

We obtained satisfactory results with this work since we had the opportunity to extend our knowledge about energy efficiency. We can improve our methodology for future presentations in the schools of Santa Rosa, with the potential to provoke more reflections and, consequently, to disseminate the guidelines to the community, thus contributing to a more sustainable and conscious future.

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CHAPTER 51

Analysis of The Knowledge in Basic Disciplines of New Entrants in Electrical Engineering of Universidade Federal do Pará and Their Evo-

lution after A Course of Leveling in Elementary Mathematics and Chemistry: A Case Study in The Years 2016 to 2018

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Abstract: Currently, more than half (55%) of Brazilian Engineering students leave the course, according to the National Confederation of Industry (CNI). At Universidade Federal do Pará (UFPA), this reflex can be seen in the course of Electrical Engineering, which has a very low ratio of graduates and among the factors contributing to this is the precarious teaching that leads the students to successive disapprovals and, consequently, their withdrawal. On the other hand, the Program of Learning Leveling Courses (PCNA) aims to reduce the rate of evasion and retention of this and the other Engineering students of the Institute of Technology (ITEC) of UFPA. The Electrical Engineering classes have shown higher adhesion rates to the basic science leveling courses offered by the program. Thus, this paper proposes to study the contribution of these courses to the students of these classes in the last three years. The methodology adopted consisted in classifying the level of knowledge of students in six categories: critical, insufficient, bad, regular, good and excellent. For this, the initial and final grades of each student were used in the final and initial exams in the subjects of Mathematics and Elementary Chemistry, from 2016 to 2018, however the performance in Chemistry can not be analyzed in 2016 due to differences in methodology adopted. After this categorization, the distribution of these levels and their evolution in each discipline was analyzed. The results showed that in all the years, there was evolution in all the precarious levels of knowledge, being some extraordinary, where the student ascended more than two levels of knowledge after the program. With all these data, it is evident that the classes and methodologies applied in the leveling courses in these classes helped the students to absorb and to know contents that it is considered necessary for the first semesters of the graduation course.

Keywords: Course of Leveling, Electrical Engineering, Evolution, PCNA, Performance.

51.1 Background

Each year, the offers of places to enter higher education in the area of Engineering are increasingly broad. However, the dropout rates of higher education courses are far from expected. In the specific Engineering courses there is a great difficulty in the adaptation of the students in the first years of the course, 64% of the students drop out of the course in the first two years [1].

Within this scenario, the Institute of Technology (ITEC) of the Universidade Federal do Pará (UFPA), through the Supervision of Student Assistance (SAEST), created in 2011 the Program of Learning Leveling Courses (PCNA) trying to circumvent these numbers and students' academic performance.

Among its actions, the program will provide students with leveling courses in Elementary Chemistry, Elementary Physics and Elementary Mathematics before the beginning of classes, in which the student receives. Upon entering and finishing the course, students are submitted to a diagnostic evaluation for each discipline. This method is based on the possibility of applying the same test to measure the efficacy of a given treatment [2].

Thus, from the progress in the grades, it is verified if there was an evolution in the classes. However, it is difficult to evaluate how this was done individually using only means, deviation, approval and evasion rate or by the distribution of certificates, and a more detailed analysis is necessary.

51.2 Purpose

The objective of this work is to analyze the evolution of the student in the leveling courses offered by the PCNA an angle that prioritizes the individual progression of each student in each discipline and, by means of this, calculate the real impact of the PCNA classes during the weeks of leveling.

51.3 Method

In order to know if the students acquired new concepts and methods for the basic disciplines of PCNA, the following criterion was used: the students should have carried out the initial and final test of the leveling course. It was verified that 80% of the frequent students (more than 15% of frequency) of the group of Electrical Engineering met the proposed requirement. This percentage of frequency is the minimum necessary for the student to have contact with some type of active methodology or any other method of teaching. After the sampling, the level of knowledge of the students was categorized into six groups according to the grade of the diagnostic tests and this occurred in two moments: at the beginning and at the end of the leveling. For this categorization, Table 55.1 was used.

Based on this categorization the class income and its leveling profile were analyzed before and after the project and also it was dedicated to study the behavior and exchange between groups of levels of knowledge previously defined from the notes of the final and initial diagnostic tests.

51.4 Results

It was verified that, in Mathematics, 63.9% of the students ascended more than two levels in 2016.In that year 55.5% presented an insufficient or critical

Table 51.1 – Knowledgement Level Classification.

Grade range	Knowledgement level
0 |— 1,00	Critical
1,00 |— 3,00	Insufficient
3,00 |— 5,00	Bad
5,00 |— 7,00	Regular
7,00 |— 8,00	Good
9,00 |—| 10,00	Excellente

performance initially and, in the end, this percentage dropped to 11,1%.

According to Figure 1, in the 2017 there was a greater amount of students with insufficient (30.3%), but no student presented a critical concept. Of this group, 50% developed. In Chemistry 33.5% of the participants were in the group considered bad initially, contrasting a majority of 39.4% in the excellent level at the end, and in addition, 57.6% evolved two or more levels.

Finally, in the year 2018, the majority of students (45.9%) went from insufficient to regular in Mathematics and no student had reached a good or excellent concept at the beginning and 91.7% evolved, being that 33.4% went up at least two concepts above. In Chemistry, the performance of students was also subtle, where 33.4% were in the regular group upon admission and 25.1% acquired an excellent concept at the end of the edition

51.5 Conclusion

The data obtained show that there was a rise in all the scarce levels of knowledge, some of them being quite significant, where the student evolved about two levels after participating in the leveling. In 2016, these data were significant in mathematics, while for chemistry, they were in 2017. With all these results, it is clear that the classes and methodologies used in the PCNA in these classes have helped the students improve and even learn content that is deemed to be necessary for the first year of graduation.

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CHAPTER 52

Green Roofs: Software Development at The University

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Abstract: Proactivity, group work and time management are essential skills for every professional who wishes to excel in the market. Developing these skill on the students is a great challenge for University. This article aims to demonstrate a way, in a University environment, to overcome this challenge with a software development methodology. Is also intended to generate a return of value to society, thus fulfilling two of the purposes of higher education established by the Laws of National Education and Guidelines: "to train graduates in different areas of knowledge, suitable for insertion in professional sectors and to provide specialized services to the community and establish a relationship of reciprocity with it". The methodology was created contemplating all the processes that involve it, from the conception of the idea to the availability of the product for use. Were generated documents that describe the purpose, requirements, simulations and validations of the software, as well as the schedule to be fulfilled and the way to manage the team. As object of the methodology was developed the Green Roofs application that contribute to solar energy development and usage. A team of three people and one former intern from the Laboratório de Engenharia Multimeios (Engemulti) and a fellow from PET - Engenharias (Conexões de Saberes) Group (PETEEECS) was composed, all from the Universidade Federal de Goiás (UFG). Based on the principles of co-operation, diligence and independence, we had the guidance of a professor at the Escola de Engenharia Elétrica, Mecânica e de Computação (EMC) at UFG and the assistance of two professors at the Instituto de Informática at UFG to accomplish this task. The results showed a well developed software and a good growth of the students.

Keywords: Software, University, Mobile, Solar, Energy.

52.1 Background

The solar energy can provide about 885 million terawatt hours (TWh) every year considering all the incidence on the Earth's surface. With that we have 6 200 times the commercial primary energy consumed by humankind in 2008. This is the reason that solar energy is the most abundant energy in earth [1].

Brazil is not out of these incredible facts. It has a greater solar incidence than several European countries like German, France and Spain and, although this incidence still barely converted to solar energy, according to the Brazilian Association of Photovoltaic Solar Energy (Absolar). Brazil has the possibility to achieve 25 gigawatts (GW) of installed power from solar energy projects until 2030 [3].

Looking at this favourable scenario, the creation of an application to go along with this growth would be a consequence. However, where this application should be made available? The research Mobile Report, showed that on the second semester of 2015 the number o people that use smartphone to have access to the internet in Brazil reached 72,4 million [4]. Therefore, the best kind of application that could receive the application would be a mobile application.

To develop this application, a project was made at the Laboratório de Engenharia Multimeios (Engemulti), situated at the Universidade Federal de Goiás (UFG). The Engemulti uses of different multimedia technologies, specially the video conference infrastructure, to subsidize various kinds of scientific and academic works, services, Distance Education and group meetings. These multimedia technologies involve all distinct kind of communication, consequently, this DNA makes it possible to the laboratory develop projects also in distinct areas, going from an artistic movement, passing thru Engineering Conference to web and mobile application development.

52.2 Purpose

This background provided a fertile soil for developing the application, constructing the main goal of the application: to make a link between possible buyers of solar panels and companies that work with these products. This link would be made by the app through his capability to do the sizing of solar panels that the costumer need, using information about the solar incidence at the client location and the amount of energy that he consume in media per month granted by the customer, providing finally, the name of the application: Green Roofs.

This way, we would be contributing first to the increase of knowledge and interest of people in the solar energy, making them more conscient about the potential and the importance of using solar energy. Established this contributing, it would be generated new customers to the companies, and for these costumers, the benefits of a green and renewable energy would be achieved.

Considering this positive return to the society and looking now for the University, the purpose of forming graduates with technical knowledge and a professional experience and abilities like group work, proactivity and project management was also achieved. The students then are able to deal with the differences and difficulties found in the work group. Ideed, solve problems that came up in any kind of activities and challenges and finally deal with pressure and discipline that the private market make on its employees. So, becoming master on skills that makes a professional successful on the market according to Forbes [6].

52.3 Design/Method

The methodology used to develop the app was able to conciliate three important goals: developing a product with a market quality capacity; produce a company environment simulating time management and high expectations and adapting to the students and University difficult and advantages. By conciliating these objectives, the development fulfilled the purposes proposed and overcame the some of the biggest challenges in software development [7].

Software specification, where the functionality of the software is defined, and software design, where the software meets the specification that must be produced, are fundamental activities to software independently of the chosen software development process affirm Sommerville [8]. Following this affirmation, the Software Design, Software Script and User Guide documents were elaborated.

The Software Script Document is a instrument that can give a brand new member of the student developers team all the background and in-software information that is needed to understand completely the software and be able to work on it. The background is the first part of it, users and purposes specification follow and by last example of expected results are described.

The Software Design Document specified, focusing on the operation and not on the visual layout, all the screens expected for the app. For each of them, it describe the text, the entities and make some comments to explain how that screen should respond to interaction. At last but not less important, the User Guide can guide the user through a walk through all of the software applications and services, not forgetting to give the client an easy and quick learning of the application.

As shown in the Stackify research, JavaScript is the second most in-demand language, losing only to Java in this question, but taking the first place back when counting the most pull requests on GitHub in 2017 [7]. A large community, heavy users and the capacity of building mobile applications for both Android and iOS made us choose React Native as the language for this job. Easily recompile the code and reload the mobile simulator to see the changes gave us quickness in the process.

The project management and version control software used was GitHub, as it is widely used by programmers as shown in researches [8]. Based on the Git system, GitHub provided us GitHub Desktop, which allowed us to easily commit, fetch, publish and execute all the common functions of version control software.

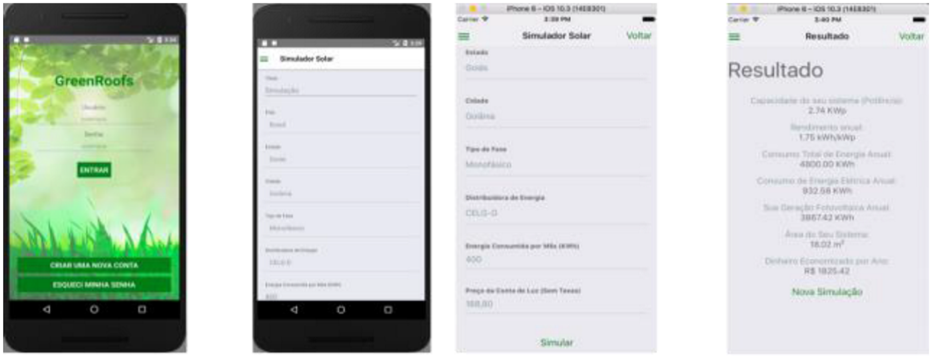
Security was also a main concern in the development of the application. To design the database two teachers from Instituto de Informática at UFG were consulted. The possible options for guaranteeing this safety: the first was to create an API (Application Programming Interface) that would be constructed with the server storing the database, exchanging data through https and SHA-256 for cryptographing the data. The other option propose a Web Service to receive and send data from the database to the app and vice versa, using the Diffie-Hellman method to encrypt the data exchange. Due to the scalability of Web Service over the established connexion of https and also due to the necessity of obtaining a certificate for the https server, we preferred to chose and implemented the second option raised.

The software development process used the fundamentals of waterfall and cyclic incremental (like Scrum) software process models. As in the waterfall model, it was planned all the process activities before starting work on them, as shown on the documents. But, due to the high rotation of students on the lab and the difficulties faced, constant validation of each module of the app (including through GitHub) were made like in Scrum. This model that works with the University and student realities and needs we called USDM, University Software Development Model.

52.4 Results and Conclusion

After about five months of development and counting on the work of three interns of Engemulti and one scholarship of the PETEEECS, the software was developed with success, and the purposes proposed were achieved.

The application is available for both Android and iOS plataforms and can be used on a smartphone or tablet. The Figures 52.1(a), Figures 52.1(b) and Figures 52.1(c) show the three interfaces of the app, respectively: login; simulation; and results screens. The first one viewed on an android simulator, the second on both plataforms and the last on an iphone simulator.



(a) (b) (c)

Figure 52.1 – Screens of Green Roof App: (a) Login; (b) Simulation; and (c) Results.

A solid documentation, instructional tips and a cooperative group made it easy to overcome the fast passage of students through the Engemulti Laboratory. The exchange of knowledge from students with teacher, the project management software and the schedule defined made it possible to grow the expected skills on the students. As a final receiver, the society has now one more tool to use solar energy.

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CHAPTER 53

Ciclo Camp Project: Bicycles Loan as An Alternative Method of Internal Mobility for The Campus do Vale on UFRGS

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Abstract: The Núcleo de Engenharia Educacional (NEED) of the Universidade Federal do Rio Grande do Sul aims to encourage the continuous improvement and innovation of Engineering Education through the development of innovative teaching practices. As a proposal, the project "Acolhimento dos Calouros – Desafio UFRGS" - 2017/1. The aim of the reception is based on the need to improve the training of the academics of the Escola de Engenharia da UFRGS and its professionalization, facing the challenges and opportunities that are

opening in all fields of knowledge. The project houses a set of projects and activities of diverse modalities related to the current needs, that is, the future engineer has to be attentive to the technological changes and ready for challenges. In this sense, the NEED, together with the concepts of active learning, proposed to the freshmen a challenge of how to make the UFRGS more sustainable, thus making it possible to associate theoretical knowledge with practice. And, through the challenge proposed came the Ciclo Camp Project, proposed by a group of freshmen of the Escola de Engenharia that aims to propose an alternative form of internal mobility in the UFRGS, which provides a faster and more effective movement to the community based on this concept of transport. The project concerns the loan of bicycles, through a mobile application, to the active students and employees of UFRGS, for internal use of the service between the dependencies of the Campus do Vale. From this concept, the present article analyzes the acceptance of loan and internal sharing of bicycles in UFRGS, besides proposing improvement actions for the aspects of greater relevance. For the implementation and possible realization of the project, the questionnaire method was used to validate the acceptance of the use of bicycles. It was defined by the elaboration and application of an instrument (questionnaire) evaluated by specialists of the area, in the sense of identifying categories of applicability and economic-applicability. The questionnaire was applied to 155 students with active enrollment in UFRGS.

Keywords: Environmental Education, Sustainable Development, Ciclo Camp Project.

53.1 Introduction

The project concerns the loan of bicycles, through a mobile app, to the active students and employees of UFRGS, for internal use of the service between the dependencies of the Campus do Vale. From this concept, the present article analyzes the acceptance of loan and internal sharing of bicycles in University, besides proposing improvement actions for the aspects of greater relevance. For the implementation and possible realization of the project, the questionnaire method was used to validate the acceptance of the use of bicycles. It was defined by the elaboration and application of an instrument (questionnaire) evaluated by specialists of the area, in the sense of identifying categories of applicability and economic-applicability. The questionnaire was applied to 155 students with active enrollment in UFRGS. As result of the respondents' profile, it was evaluated that it is largely composed by students who are present in more than once a week in the Campus do Vale, with classes divided in more than one shift, being mainly morning and using public transportation as a method to getting in to the Campus. It is important to emphasize that more than half of the interviewees live in the metropolitan area of Porto Alegre and for more than 20% of the interviewed students, there is no public transportation that routes the central part of Campus Vale and therefore, based on the diagnosis, the Ciclo Camp project can be implemented in the Campus Vale of the UFRGS [1-6].

53.2 Methodology

For the implementation and possible realization of the project, the questionnaire method was used to validate the acceptance of the use of bicycles. It was defined by the elaboration and application of an instrument (questionnaire) evaluated by specialists of the area, in the sense of identifying categories of applicability and economic-applicability. The questionnaire was applied to 155 students with active enrollment in UFRGS. The research is structured in three major phases: a diagnosis that was performed through the application of a questionnaire, validation of the data and analysis of the results obtained. As result of the respondents' profile, it was evaluated that it is largely composed by students who are present in more than once a week in the Campus do Vale, with classes divided in more than one shift, being mainly morning and using public transportation as a method to getting in to the Campus. It is important to emphasize that more than half of the interviewees live in the metropolitan area of Porto Alegre and for more than 20% of the interviewed students, there is no public transportation that routes the central part of Campus Vale and therefore, based on the diagnosis, the Ciclo Camp project can be implemented in the Campus Valley of the Federal University of Rio Grande do Sul. About the studies on the use of bicycles as an alternative transport, further research on new methods for the creation of bicycles with waste materials such as plastic, metal or cellulose is recommended.

53.3 Discussion and Results

Based on the analysis of the answers obtained in this study, it is possible to conclude that for 60% of the interviewees there were delays for the class period to the detriment of the distance between the main points of the Vale Campus, and for a little over 70% of the respondents were unable to have lunch or dinner at the University Restaurant due to the delay in locomotion between the University Restaurant and the classrooms. For more than 80% of the sample there is confirmation of the need to offer other methods of travel within the Campus, with the same percentage of respondents stating that they would use bicycles on routes that would facilitate and save time. For practically 100% of the interviewees, using bicycles is considered a clean transportation method that assists in physical conditioning. For exactly 80% of the respondents, there is acceptance of a semi-annual symbolic payment for the use and maintenance of the bicycle loan service, and almost 82% would accept installing a mobile application that would provide service information.

53.4 Conclusion

Based on the diagnosis, it is possible to confirm the need to implement the Ciclo Camp project in the Campus do Vale of the Federal University of Rio Grande do Sul. The circular economy model to will be used in this work brings the perspective of manufacturing the components of bicycles and stations of collection with the metallic residual from the University itself. The institution is a potential laboratory for the transition to the circular economy, enabling teachers and students to develop knowledge and put into practice what is presented in the classroom. In this way, reusing the metallic materials that would be destined to the end of its useful life, there is a challenge coupled with opportunities to align itself with a restorative and regenerative economy of the environment.

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CHAPTER 54

Project Based Learning: The Integration of Knowledge, Skills and Attitudes through The 4x4 in Schools Challenge

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Abstract: The present work describes an exchange of experiences among students of the State School CIEP 291 - Dom Martinho Schlude in Pinheiral, RJ, with the students of Advertising and Propaganda, Information Systems and, mainly, students of the Engineering courses of the University Center of Volta Redonda (UniFOA) for a period of six months. The main motivation for the University students in the project was the social entrepreneurship because the school is located in a peripheral municipality with a high illiteracy rate, with the

lowest rate of Development of Basic Education (IDEB) in the South Fluminense region (RJ). The 4x4 In Schools Challenge is a Jaguar Land Rover competition for high school students who may have as tutors, Higher Education students and/or Research Center professionals. To participate each High School team must promote several technological changes in a prototype of a 4x4 vehicle approximately 20 cm long, 10 cm wide and 10 cm high. It is also necessary for the teams the structure of a microenterprise, with logo and marketing actions, approaching an entrepreneurial vision. All actions taken were exposed through verbal presentations and evidence of car performance on obstacle courses. Therefore, CIEP 291 created a partnership with UniFOA to assist in the development of an electric/mechanical prototype design, as well as advertising and marketing support. After defining the support, three teachers and twenty five students participated in the course of Information Systems, Electrical Engineering, Mechanical Engineering, Advertising and Propaganda, two professors from CIEP 291 and six students who would compete. For University students, an Academic Extension and Scientific Initiation Project was created with two hours of weekly work during the competition period. At University, teachers decided to use Project-Based Learning as a teaching methodology, with students separated into small work groups according to the needs of each area. Subsequently, the University students played the role of tutors and facilitators in the teaching-learning process with the team of CIEP 291. The school

teachers were guiding the proposed tasks by monitoring a work plan so that all the requirements were fulfilled in the established term. As an outcome, the CIEP291 team managed to develop all the necessary requirements, therefore became the national champion in the Beginner Mode and received three individual prizes in the competition. As a result, it was qualified for the World Competition Stage competing with twenty-four teams from sixteen countries, ranking first in marketing and among the top three in terms of technological innovation. We believe that the methodology used in the project was very enriching, strengthening and stimulating the main skills, abilities and attitudes of the students, in both segments, due to the relevance of meaningful learning, offered by the needs in solving the real problems proposed by the competition.

Keywords: 4x4 Challenge, Higher Education, High School, Project-based Learning, Technology.

54.1 Background

In today's world, entrepreneurship has been a great tool of relevance for professionals in the 21st century[1-3]. Considering that this project allows to develop different abilities in the students such as capacity of interaction, new knowledge aquisitions, learning of new technologies, stimulation to creativity and resilience, the main motivation was the possibility of transforming the life of students from a public network of education through this innovative experience using a methodology in which they developed the leading role in teaching and learning. To achieve the result it was necessary a partnership with students of the University Center of Volta Redonda Who were willing to apply their academic knowledge in a demand of the society.

54.2 Purpose/Hypothesis

The purpose of this project was to integrate Basic Education with Higher Education in order to produce knowledge so that high school students could develop a prototype of remote control for a competition entitled 4x4 in Schools promoted by Jaguar Land Rover.

Among the objectives of each team were the creation of a logo, search of sponsors, installation of sensors, creation of a body for a chassis received from the organizers, assembly of a booth, elaboration of a portfolio about the whole project, performance of the miniature in time-trials on various obstacles (bridges, tunnels, uneven terrain and etc.)

54.3 Design/Method

The methodology used in this study was Project-Based Learning[4-7] both among University students and among high school students. At first, the University professors discussed with the high school teachers the regulation and the requirements in the different areas. After clarifying the needs that the competition required, the teachers of the Mechanical Engineering and Electrical, Information Systems and Advertising/Propaganda courses gathered some students and began to discuss, it lasted the period 6 months, which the conversations were about two hours a week therefore they were able to set how to meet the demands required.

The University students began a series of studies where the teachers had a role of facilitators in this process of teaching and learning that lasted for two months. After acquiring the knowledge they became the tutors of high school students, providing technical monitoring for four months. Students of Engineering and information systems taught programming in arduino, they taught notions of the program Corel Draw for the portfolio’s team and also mechanical systems for a better development and performance of an off road car.

The Advertising/Propaganda students were responsible for teaching how to define a business plan for sponsor aquisition, they also were responsible to guide the group of students on how to get a more effective use of social media and booth definitions that could present the final product

54.4 Results

AUTO291, team formed by high school students, was able to develop all the obligations so that they could participate in the annual Jaguar Land Rover competition. In possession of the chassis received from Jaguar Land Rover and also the help of technical monitoring, they were able to develop and deploy the inclination sensors so that the car would trigger a sound signal when it reached 25º laterally, the light and approach sensors; they modeled a 3D body using Fusion 360 for the vehicle chassis; installed a breathalyzer in order to measure the rate of alcohol ingested by a driver. They also managed to build the portfolio and booth in order to disseminate the final product. In the performance tests the prototype created managed to overcome all the obstacles of the competition. As a final result AUTO291 became the national champion representing the country in the world event of the automaker receiving the award for better product dissemination in social media and among the three best in the technological innovation modality.

54.5 Conclusion

The results of the Ciep 291 Dom Martinho Schlude team in an international level competition opened the door to a paradigm shift in public education in our country. Society has stigmatized students in the public system by announcing that education in these type of schools are not able to make a difference in the lives of learners.

Although, the technical and socio-emotional knowledge acquired by University and secondary students makes it clear that a real integration of the University and society is possible, promoting the transformation in the lives of all those involved. The University's role was to present itself as a collaborator. The interest of the University students in the project was also relevant to the success of the team, always willing to develop the four pillars of education as advocated by Jacques Delors[8].

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CHAPTER 55

Web Lab Platform: An Approach to The Study of Mobile Robotics

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Abstract: Nowadays the robotics systems has been broadly used in college education as a very important learning tool to lure and rise the teaching-learning process inside to the Engineering courses. The students achieve higher motivation in performing laboratory aimed to the formative contents development. Another practice utilized by educational institutions consists in the Web Lab concept, that corresponds to the remote experimentation laboratories. The incorporation of this process in the systematic teachinglearning in Engineering education, makes possible carrying out real-time experiments through the internet, fact that helps the development of the student during the training process. Furthermore, one of leading training content of mechatronics Engineering and automation consists on robotic mobile systems programming. However, some educational platforms to remotely control robots have been present some difficulties on their final objective. Mainly because the methods shows problems as a complicated integrated development environment (IDE), special and expensive hardware and software to control the robots, non-free platforms and still lack of compatibility at networks and industrial protocols. The approach used in this work employs an embedded system in a mobile robotic platform with Wi-Fi connectivity, which allows its parameterization, control and programming remotely. The solution also enables video supervision and real-time access to the remote environmental information. This method provides a browser-based editor that makes easy to wire together flows using the wide range of nodes, using block oriented programming that can be deployed to its runtime in a single-click working on the cloud. The greatest advantages of the developed system are to be open-source, modular, inexpensive, and simple enough to be assembled by most researchers, professors and students. Thus, with the platform in question, teachers can develop experiments aimed at problematizing the formative contents that make up the practice of programming robotic mobile systems, making the student to learn in a practical way the characteristic aspects of mobile robotic systems.

Keywords: Engineering Education, Mobile Robots, Modular System, Open-source, Web Lab.

55.1 Background

The changes in the teaching-learning process present a considerable presence of new technological tools. This process, which previously had the teacher as responsible for the decisions related to teaching, has undergone a transformation where the student begins to assume a greater responsibility in the search for knowledge[1-2]. This new learning approach suggests that the student assumes a more active and responsible role during the process of knowledge formation. One of the ways to stimulate the student's pursuit of knowledge is to involve him in performing practical activities involving experimental tests that generate some kind of result that can be analyzed. Emancipating student thinking is part of a strategic pedagogical activity to be incorporated into higher education institutions. In this context, the focus of educational work ceases to be teaching and becomes learning. According to Setzer [3], a student can only be considered competent in any area if he demonstrates, through achievements, the ability to perform a certain task. However, disciplines such as robotics or control systems often require expensive equipment and difficult access to practical classes, in addition to the educational institutions that hold these equipment, most of the time, do not have enough to allow that all students use them.

55.2 Purpose/Hypothesis

In response to the challenges of conducting hands-on classroom experiments, one tool that contributes to the learning process is the remotely operated labs or WebLab's. Due to advances in several areas, including information and communication technology, WebLabs consist of laboratories that integrate laboratory and computational equipment allowing the realization of real experiments through remote operation, through the Internet, using images resources, sounds and data. Unlike the virtual experiments that make use of simulators, the WebLabs provide greater interactivity with the executed experiment, allowing a greater sense of realism.

In this context, the present work proposes the development of a mobile robotic system capable of being controlled and programmed remotely, besides enabling the functionality to be visualized at a distance and in real time.

55.3 Design/Method

The Figure 55.1 shows the block diagram of the developed robot, where it is possible to visualize the main components used in its assembly. DC-type motors were used to provide the robot motion, and for powering them, power systems based on H-bridge were used, in addition to encoders to determine the speed of rotation and position of each motor. Also used were ultrasonic sensors and GPS, whose function is location. The educational platform is based on the Raspberry pi development board which already has WIFI connection, enabling Web-Lab realization.

In the Raspberry pi development platform, the node-red programming tool for wiring together hardware device was installed. It provides a browser-based editor that makes it easy to wire together flows using the wide range of nodes in the palette that can be deployed to its runtime in a single-click. Together, an IP camera is used that can be accessed remotely together the node-red programming interface of the student's personal computer, which can be seen in Figure 55.2.

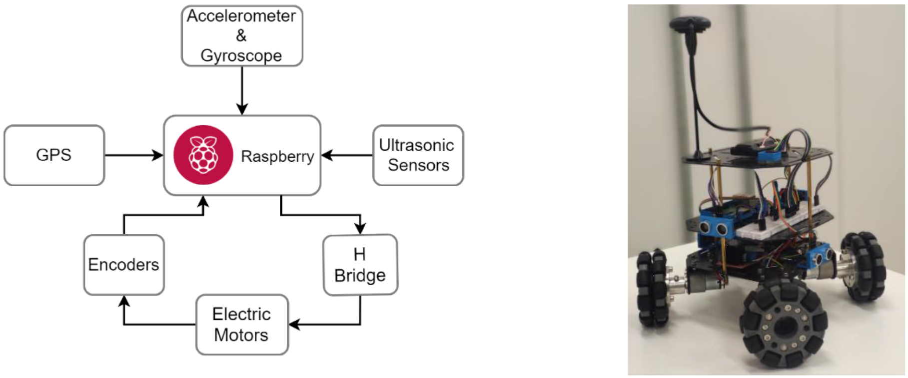

Figure 55.1 – Block diagram of the robot.

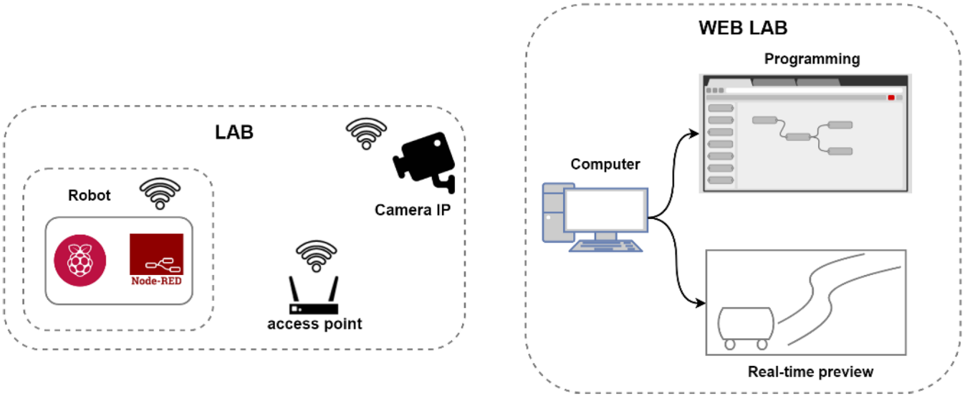

Figure 55.2 – Block diagram of the system.

55.4 Results

In the present work we focus on the implementation of a low cost remote lab, ande which the components used and the network structure mounted, it was possible to implement a web lab with few financial resources and with great functionalities. Choosing the use of the Node-Red development environment together with Raspberry pi makes it possible to program robotic algorithms in a very simple way, and the video feedback of the movements performed by the robot provides a learning experience very similar to practice praised locally.

55.5 Conclusion

With the implementation of the proposed system, it was possible to verify that the learning experience provided is closer to reality when compared to simulations, a method widely used today. It is clear that the student is more attracted to real practice rather than simulations, and his motivation can broaden his knowledge and drive learning and establish the conditions under which it occurs.

As a future proposal for this work, it is intended to modify the the user interface, in order to provide a more user-friendly environment, and in addition it is considered the preparation of a training material for teachers to facilitate exploitation of the platform during their classes.

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CHAPTER 56

Clown Group: Humanistic Training for Engineering Students

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Abstract: s. The theoretical basis of the Clown Group goes back to the origins of Jerzy Grotowski's "poor theater" (1933–1999). Concerning the use of music, theater and dance to present and promote the pleasure of art, the Group values the interaction with the public and does not worry about the structural

elements commonly characterized by the theater as stage and lighting. In this way, the Clown Group promotes a Humanistic Formation of its members by providing a development in the capacity of communication, contact with the external community and also the satisfaction, by allowing the art to be spread in a simple and effective way. The objective of this work is to analyze the importance of Humanistic Training in the professional and personal development of Engineers and Engineering students, treating as a special case the Humanistic Training linked to the actions of the Clown Group – Engineers without Borders (Knowledge Connections). As a hypothesis, it is expected that the experience of members and ex–members of the Clown Group can be proven through their training and presentations over the years. In order to evaluate the personal and professional development of members and ex–members of the Clown Group during the training process, a qualitative research was carried out, via an applied questionnaire, in addition to a documentary research by observation, in which data were collected through analysis and observation of photos and documents of the Clown Group. In addition, Artificial Neural Networks were used to correlate the members and ex–members based on the two applied researches. The members and ex–members of the Clown Group have experienced a major break in introspection, significantly improving their way of communicating with society. The members and ex–members presented an improvement in the way they relate to each other in a team, a fundamental

aspect of an Engineer's professional life. The Clown Group presents itself as a very important action for Humanistic Training and the professional and personal development of Engineers and Engineering students. The diffusion of art in the academic and external community promoted by the Clown Group also allows the deconstruction of the stereotype that the areas of Engineering and the Arts cannot coexist.

Keywords: Art, Communication, Humanistic Training, Clown, Tutorial Education Program.

56.1 Background

The Clown Group - Engineers Without Borders (Connections of Knowledge) is a group of clowns formed by Engineers and Engineering students. The theoretical basis of the Clown Group goes back to the origins of Jerzy Grotowski's Poor Theater (1933-1999)[1]. Concerned with the use of music, theater and dance to present and promote pleasure for art, the Group values the interaction with the public and does not worry about the structural elements commonly characterized by theater as stage and lighting . In this way, the Clown Group promotes a Humanistic Formation of its members by providing a development in the capacity of communication, contact with the external community and also the satisfaction, allowing the art to be spread in a simple and effective way.

56.2 Hypothesis

The main goal of this work is to analyze the importance of Humanistic Training in the professional and personal development of Engineers and Engineering students, treating as a special case the Humanistic Training linked to the actions of the Clown Group - Engineers Without Borders (Connections of Knowledge). As a hypothesis, it is hoped that the experience of members and former members of the Clown Group can be proven through their training and presentations over the years.

56.3 Method

In order to evaluate the personal and professional development of the members and former members of the Clown Group during the training process, a qualitative research and a documentary research by observation were carried out. In addition, Artificial Neural Networks were used to correlate the members and former members.

56.4 Results

The members and former members of the Clown Group have experienced a major break in introspection, significantly improving their way of communicating with society. and showed an improvement in the way they relate to each other in a team, a fundamental aspect of an Engineer's professional life.

Figure 56.1 shows the interaction between the Clown Group and the public on the streets during the presentation "Street Parade and Connections of Knowledge" [2].

Figure 56.1 – Interaction with the public on the streets during the presentation "Street Parade and Connections of Knowledge".

56.5 Conclusion

The Clown Group have experienced a major break in introspection, significantly improving their way of communicating with society and allowing the deconstruction of the stereotype that the areas of Engineering and the Arts cannot coexist.

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CHAPTER 57

Teaching and Design of Fuzzy Controllers Made Easy with The Crookes Radiometer

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Abstract: The Crookes radiometer, also known as the light mill, was invented in 1873 by the British chemist and physicist Sir William Crookes, it consists of a sealed glass bulb containing partial vacuum and four vanes forming a propeller supported on a low-friction spindle allowing free rotation. The vanes start to rotate when exposed to light. The explanation of this movement has been debated by the scientific community for a long time and today the accepted reason is related to an infra-red light induced thermal effect that produces torque. It is a fact that the radiometer can be used as an instrument to detect and even measure the infra-red energy by measuring the rotational speed of the vanes when exposed to such radiation. By having a low-cost, being easy to find and awake strong curiosity, the instrument can be considered a viable alternative for the development of an enhanced educational platform including a digital control system for the vanes' rotational speed. The developed platform consists of open software and hardware allowing to interface with the radiometer, the speed sensor (optical detector) and the actuator (infra-red emitter) by handling all the controller design in a user-friendly interface in a computer. The platform aims to facilitate the design of digital controllers, giving students the possibility to implement what they just learned in theory in a practical application, resulting in a better teaching quality, as the students understand better the theory and increase their confidence in the effectiveness of the designed controller. Previous work, presented an educational platform as an alternative for the teaching of classical PID controllers design, but the system was initially developed with analog components and a microcontroller kit hard to find and quite expensive, also requiring a higher complex level of programming. Here we demonstrated an enhanced platform using the Arduino Integrated Development Environment and the implementation of a Fuzzy controller for the speed rotational control logic, reducing hardware cost by more than 70%, facilitating the system set up and the programming trough a friendly environment. This new control algorithm allows the study of techniques frequently presented in elective control courses in Engineering schools. Design of digital control systems are often based on theoretical case studies, with the new proposed platform, a Fuzzy control system implementation in a real plant can be presented to the students, facilitating and complementing the understanding of the theory classes.

Keywords: Arduino, Crookes' Radiometer, Digital Controller Design, Fuzzy Controller, Teaching Tools.

57.1 Background

The importance of teaching using practical activities is unquestionable and should have a central place in courses[1], such real experiences provide to students a chance to build their own knowledge, making the learning of science and technology more than a simple understanding of concepts. However, many Brazilian educational institutions have few structural resources what difficult the execution of practical activities, compromising the full teaching of students. Brazilian public Universities, have suffered from successive government budget cuts, interfering on the basic operational maintenance and slowing down new investments in equipment for teaching and research[2]. The main problems observed are lack of physical space, limited financial resources, overcrowded classrooms, teacher shortages, lack of materials, outdated materials, among others. Taking into account such shortcomings, it is necessary to use optional materials of easy access and low cost for the development of researches and improvements of teaching, in this sense the Crookes radiometer shows up as a viable alternative.

57.2 Purpose/Hypothesis

The Crookes radiometer is an instrument composed of four vanes supported by a vertical pin in a low pressure gas bulb. The device is used to measure and detect the energy intensity by measuring the vanesrotational's speed when exposed to a radiation source. The public appearance of the radiometer was in the year 1873 when Sir William Crookes was studying the effect of infrared radiation on the newly discovered chemical element Thallium. The explanation of the vanes movement has been debated by the scientific community for a long time and today the accepted reason is related to a thermal effect[3].Considering the Crookes radiometer was invented more than a century ago, the fascination the instrument causes at first sight is still spetacular, the developed project aims to improve the knowledge of such instrument in the academic community, combined with the study of modern control through a didactic platform of easy construction and low cost. This paper presents an educational platform that uses the rotational speed of the vanes as the controlled variable for the study, implementation and tuning of Fuzzy controllers.

57.3 Design/Method

In this paper the study of Fuzzy controllers was based on a quantitative approach, with exploratory data analysis of the experience. The quantitative method proved to be adequate for the controller validation, since it allows analyzing the precision of the results avoiding distortions of analysis and interpretation[4].The platform allows students to apply the theoretical knowledge of digital control in a practical case, oriented to solve the problem of controlling the vanes speed rotation. Based on a prototype developed and implemented in 2014 by the authors[5],a new platform was built using Arduino hardware and free software as its main element. In addition to the change of the microcontroller, improvements in measurement and power circuits were made with the objective of reducing costs and simplifying the platform. In Figure 57.2 is presented the block diagram of the platform with its main components. An application developed in Matlab® is responsible for controlling the radiometer in real time and by the user interface for the visualization of parameters such as speed, error, control action and controller type. The photodetector and the laser compose the measurement system for the vanes angular velocity. The power control circuit developed for the platform is responsible for the activation of the lamp, allowing variation in intensity of light and consequently modifying the speed of radiometers' vanes presented in Figure 57.1.

57.4 Results

In the present work we focus on the implementation of a Fuzzy logic controller, which consists on a control system that provides response to a given input according to a set of rules of inferences modeled from human experience. As the radiometer is difficult to modeling, the fuzzy controller proves to be an interesting alternative solution. The experience of an operator is used on the mathematical model for the control action.

In order to facilitate the design and learning of Fuzzy controllers all per-

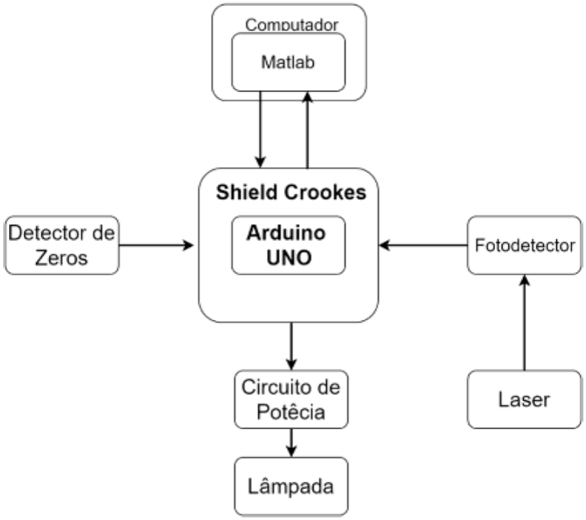

Figure 57.1 – Block diagram of the platform.

tinence functions and inference rules can be configured byusing the Matlab Fuzzy ToolBox. The performance of the Fuzzy controller was analyzed for an initial tuning when the speed set point of 2 rps is chosen. The speed rotation became stable after 20s with a steady-state error below 5%. The controller can stillbe optimized to achieve a faster performance. As we can notice this result is four times faster than the PI controller proposed by Arenas[6]. The new platform based on the arduino board combined with the new measurement system and the power circuit board contributed to a cost reduction of more than 70% when compared to the first version, which facilitates use on public Universities.

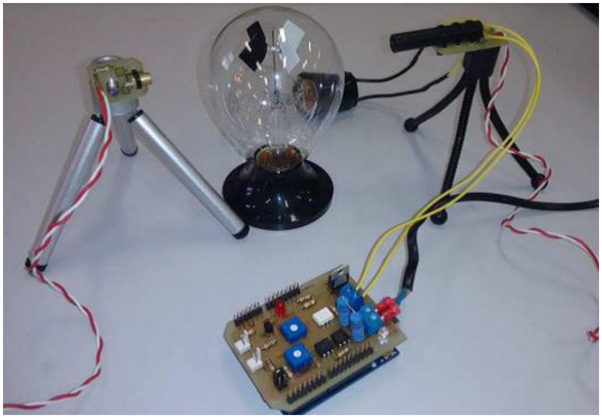

Figure 57.2 – Crookes radiometer educational platform.

57.5 Conclusion

By moving due to the light incidence, the Crookes radiometer awake strong curiosity in people, especially on Engineering students or related areas, who have a special interest in understand its operation and physical behaviour. This attraction can be used as a motivational factor for the study of its control and can be exploited by teachers during modern controlclasses combining theory and pratical activities. This new educational platform can be used as an important tool for the teaching of modern control theory, allowing a better understanding of the fundamental concepts and techniques of controller tuning, oreven more robust controllers based on Fuzzy logic.

As a future proposal for this work, it is intended to modify the pertinence functions and rules of inference in order to optimize the controller performance and then compare with other techniques such as PID control or neural networks based control. In addition it is considered the preparation of a training material for teachers to facilitate exploitation of the platform during their classes.

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Made in $\LaTeX$.

This book brings experiences that, rather than being an example, serve as a provocation. Although Engineering degrees are widely recognized for content density and for requiring a lot of dedication from students to complete them, are these enough to form Engineers capable of performing their duties in the Society? Are the graduates of the Engineering courses prepared to work in an increasingly competitive and innovation-oriented market?

The answers to those questions should be sought even during the training of the students if we assess what students are effectively able to do with the training already received. Another concern must be the development of professional skills at each study year. Besides technical competence, is there stimulus for creativity and capacity building for innovation?

The works collected in this book reveal how imperative it is to gradually give students opportunities to express their skills and abilities in the face of real world problems. Active methodologies and the use of new technologies present themselves as efficient ways of bringing these demands into the classroom, but extension activities bring students closer to Society and impose challenges that motivate them. Experience has shown that innovative solutions to Society's demands arise from those challenges, often with a direct impact on quality of life and social promotion.

We hope that the accounts of this book will enrich and raise awareness for new paradigms of formation with positive results for economic and social development.

Rodrigo Pinto Lemos

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