Alternative Method of Internal Mobility for The Campus do Vale on UFRGS

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Abstract

The Center for Educational Engineering (NEED) of the Universidade Federal do Rio Grande do Sul, School of Engineering has fostering the continuous improvement and innovation of Engineering Education through the development of innovative teaching practices as its goal. The
project “Freshmen Reception – UFRGS Challenge” was created in 2017 as proposed. In this sense, NEED drawing from concepts of active learning issued to the freshmen the challenge of how to make UFRGS more sustainable, making it possible to associate theoretical knowledge with practice. Through the proposed challenge, the Ciclo Camp Project was developed by a group of freshmen from the SE’s various Engineering courses, who suggested an alternate mean of internal transportation within the Campus do Vale. The project aims to provide a new form of transit for the student community, grounded on the concept of clean transportation. The project is about the rental of bicycles through a cell phone application to active students and staff members at UFRGS, for internal use within the Campus do Vale. Stemming from this concept, the present article weaves an analysis of the acceptance of internal bicycle rental and sharing at UFRGS, besides proposing actions for the improvement of its most relevant aspects. For the evaluation and possible realization of the project, it was decided to elaborate and apply a survey to 155 currently enrolled students at UFRGS, in order to identify categories of applicability and economic applicability. The survey is structured in three major phases: a diagnosis performed through the questionnaire, validation of the data; and analysis of the obtained results. As a result, it was observed that students reported being late to classes throughout the academic term due to the distance between the main locations of the Campus as well as claimed that the use of bicycles is a time-saving and facilitating method. As such, the students agree to make a symbolic payment for the maintenance of the bicycles, as well as to utilize the cell phone application. The need for the implementation of the Ciclo Camp project in the Campus do Vale could be verified based on the diagnosis. After conducting the analysis of the results, an action plan was put in place, based on the Golden Circle process, a concept developed by leadership specialist Simon Sinek in order to create and develop the value of new ideas through a simple methodology. For the studies on the scope of the usage of bicycles as sustainable means of transportation, it is suggested through this article that the bicycles for the Ciclo Camp Project be made in the institution’s metallurgical laboratories out of scrap metal coming from UFRGS itself.

Keywords: Environmental Education, Sustainable Development, Circular Economy.

1. Introduction

The Center for Educational Engineering (NEED) of the Universidade Federal do Rio Grande do Sul (UFRGS), School of Engineering has fostering the continuous improvement and innovation of Engineering Education through the development of innovative teaching practices as its goal. The project “Freshmen Reception – UFRGS Challenge” is one of its proposals. The receptions’ objective is to enhance the training and professionalization of UFRGS/Engineering School students, in light of the challenges and opportunities arising in all areas of knowledge. The project proposes a diverse range of activities related to current needs, that is, the future Engineer needs to be watchful for technological changes and ready for new challenges. In this sense, NEED drawing from concepts of active learning issued to the freshmen the challenge of how to make UFRGS more sustainable, thus making it possible to associate theoretical knowledge with practice.

The Ciclo Camp Project is composed of a group of five incoming freshmen enrolled in the bachelor’s courses of Metallurgical Engineering and Energy Engineering. The developed project prioritizes introducing a new mode of transport to the UFRGS. Initially, it contemplates providing six bicycles for exclusive use within the Campus do Vale, through a rental system via cellphone application, conditional on the contribution of a symbolic sum each semester. This resource will be allocated to the maintenance and expansion of the fleet of bicycles. In this way, the service will be made available to active students and staff at UFRGS through their University registration number. Three spots for borrowing and retur-
ning the bicycles will be located at high-traffic points in the campus, these being: the front gate; University Restaurant 6 (RU); and the entrance between the Physics and Chemistry Institutes. Each point will feature a parking rack with six slots under a cover for conservation against the environment. The bicycles will be fitted with a basket and a dynamo to power the batteries for their security night lights.

In this sense, Ciclo Camp Project follows the premise of guaranteeing of sustainable systems between its pillars and shares the ideal of minimizing negative impacts as being of extreme importance. Therefore, it bases itself on the methodology of critical environmental education, aiming to generate an environmental reality that transcends traditional education. Society in general demands the incorporation of transformative methods in search of sustainability; therefore, the UFRGS community becomes part of this new reality. The concept of Circular Economy can be identified in the fact that, with this project, we are proposing a solution to minimize the human impact in the environment for use together with the various modes of transportation already existing and adapted to the Campus do Vale. The purpose of this project is not to increment the amount of externally acquired material goods for the institution, but to reuse metallic residue originating from the foundry laboratories as material for the bicycles used in this project. The justification for the Ciclo Camp Project will be presented below.

2. Justification

The Ciclo Camp Project arose from the need to broaden the range of means of transportation in the Campus do Vale, and it boasts the following qualities:

- Causes improvement in the users’ physical conditioning due to the use of bicycles;
- Better time efficiency and organization by its users;
- Agile and efficient transportation between sectors of the Campus do Vale; and
- Collaboration between different Engineering courses for the development of improvements and the continuity of the project.

According to Fabiano, the usage of bicycles as an integrated mode of transport over other options “represents not only environmental and economic advantages, but also contributions to the advancement of the city and social equality, as well as democratizing the use of public space”\(^1\). In this case, the Campus do Vale presents the required qualities for the introduction of the aforementioned democratization mechanisms. The practice of public bicycles is already widespread in Europe. The Velib project in Paris, for example, already has 18,000 bicycles available, 1,200 rental spots and over 70,000 daily users\(^2\). Also according to the authors, it is necessary to educate students and staff members on the benefits occasioned by a change in mode of transportation, not only within the campus, but also across the whole city, because, beyond such a change being economically viable, it would also represent a sharp decrease in the emission rates of pollutant gases which are as harmful to human health as they are for the environment.

With the same goal of integration and social democratization, the Ciclo Camp Project employs in its methods premises specified in the Brazilian Law n°12.587, art. 7° of the National Policy of Urban Mobility (PNMU) as follows: I – lower inequalities and promote social inclusion; II – promote access to basic social services and equipment; III – provide improvement on the urban condition of the population with regards to accessibility and mobility; IV – promote sustainable development by mitigating environmental and socioeconomic costs on the movement of people and cargo in the cities; and V – consolidate democratic management as an instrument and guarantee of the improvement of urban mobility.

In this sense, for the authors Thomas and Callan (2010), each and every resource which
is transformed by economic activity ends its life as waste and potentially degrades the environment, that is, the process can be delayed by the recovery of materials, but not interrupted. Another observation is that nature’s ability to convert resources into other forms of matter and energy is limited. Based on these premises, the Ciclo Camp Project proposes that the creation, development and maintenance of the project’s scope be managed by the UFRGS institution itself, integrating different courses for the sake of sustainability. The income derived from the regular contributions will be allocated to the maintenance and development of the project through extension research, fostering the students’ intellectual and creative development with the help of the institution’s faculty.

3. Theoretical Framework

3.1. Center for Educational Engineering (NEED)

In order to encourage continuous improvement and innovation in the teaching of Engineering, the School of Engineering’s (SE) is established with the goal of guaranteeing the excellence of the Engineers trained there, through the development, renovation and dissemination of educational practices. It’s main objective is the continuous improvement of the teaching-learning process by through means of motivation, reward and recognition, through quality pedagogical action, constructing positive synergy.

Furthermore, it involves SE’s professors and students, who are invested in the improvement of education through initiatives and projects, promoting the sharing of experiences between pupils and faculty regarding educational practices and providing guidance and support to the development and utilization of pedagogical activities. Among the first projects promoted by NEED, the creation of the Directory of Pedagogical Activities (BAP), consisting of a repository of classroom exercises and activities developed by teachers and students of the School and Engineering and the NEED, stands out. BAP aims to share pedagogical activities and experiences with the entire faculty and become a reference for the development and utilization of innovative pedagogical practices. It also aims to guarantee the excellence of education and training of Engineers with the technical qualities, skills and competencies demanded by the market.

3.2. Active Learning

It is a term used to describe a set of pedagogical practices that make the student active through interactive classroom practices, where the student is not merely a vessel to be filled with knowledge by the professor, but also interacts in order to learn, appropriating knowledge and skills, the educational process and the learning. Still regarding active learning, according to Moran, Masetto and Behrens active learning is more appropriate for classroom work, because it hedges its bet on the student the protagonist of the learning process. Furthermore, active learning is performed through different methodologies, such as PBL (Problem Based Learning), PLE (Project Led Education) and Project Work. In the present work, the focus is on Active Learning, due to it being the practical-theoretical method that guides practices in which the subjects of this article are involved, as well as providing support for academic learning. In this sense, active learning assists in the educational and learning process, that is, the student takes active part in the process, in which classes are interactive, dynamic, appropriating knowledge and skills, making it possible for the student to be reflective and a lifelong learner.
3.3. Environmental Education

A theoretical Environmental Education project is based on a liberal view of the world, in which societal transformation is a consequence of the actions of each individual, requiring only that each is taught what is right. In a critical conception of Environmental Education, there is reciprocity of the processes which results in societal transformation as a cause and consequence of transformation in the individual. In this sense, educator and educate are active social agents in the process of societal transformation. Through this context arises meaning of a Political Education in which the environmental educator inscribes the sense of their action in taking a stand as both an educator and a citizen, aggregating the meaning of their action.

Whilst to Lima, one of the focuses of criticism to the prevailing economic development model is the contradiction present in a proposal of unlimited resource development from a finite base. In consensus, Guimarães expounds that the ecological and economic problems reveal dysfunctions which are characteristic of a certain style of development; problems caused by unequal development for human societies; and harmful to natural systems. Sachs speaks of three pillars necessary for ecodesvelopment: economical efficiency; social justice; and ecological prudence.

As such the awakening of ecological conscience is substantiated by critical reasoning, in which Environmental Education aims for sustainability of life on the planet, promoting fundamental breakaways and re-connections to a new paradigm. This is the way in which the interdisciplinary of Environmental Education is presented as being the construction of a complex knowledge that seeks to better reflect a complex reality. The authors also claim that we must overcome the notion of sensitization. It not enough to only understand what is right or wrong. There must also be a feeling of belonging to nature. For that, it is necessary to incorporate reason and emotion to the environmental question in our daily lives as a priority, and to adopt a new worldview through a change of attitude with ourselves and an act of solidarity stemming from the interaction of human being and the environment. A new model of environmentally sustainable society must involve social justice, in which society values the relationship of balance with the environment.

3.4. Economy and the Environment

According to Thomas and Callan, we are going through a process of adequation, as a society, since we still need to learn about nature and market behavior, as well as the important relationships interconnecting these two elements. It is through the contribution of the economical sciences that these learning are made available, given that they help explain the interactions between market and environment through analytical tools.

Also according Thomas and Callan, environmental problems arise due to decisions taken by citizens and companies, as both of them make use of natural resources for consumption and production. In accordance, Giannetti stresses the need for a critical examination of current needs and consumption patterns, reviewing the purposes of economic production and prevailing social values, which also involve individual attitude.

Furthermore, B. Field and M. Field report that the processes and changes of an economical system are governed by natural laws and that the economy makes direct use of all kinds of natural assets. One example given by the authors is the usage of raw materials for the maintenance of the system. “Activities of production and consumption generate leftovers or residual products, called ‘waste’, which sooner or later must find the way back into the natural world.”
Giansanti says that “the perspective of sustainable development leads to questioning and rethinking consumerism. It is not possible to equate the finite nature of the resources without changing consumption and production habits”\textsuperscript{11}. To illustrate the relationship between consumption and production using natural resources, the authors Thomas and Callan demonstrate the model of Balance of Materials. In it there is an explicit relationship between economic activity and the natural environment, according to Figure 1.

![Figure 1](image_url)  
**Figure 1. Model of the balance of materials, Kneese, Ayres and D'Arge (1970)\textsuperscript{10}**.

According to the same authors, the economy of natural resources focuses on analyzing the natural resource flow towards economic activity\textsuperscript{10}. For Stephanou among the environmental impacts caused by economic activities developed in a society, the generation of solid waste is present, in a small or large scale, in the majority of situations\textsuperscript{13}. To B. Field and M. Field the term sustainability signifies a connection between the usage of resources in the present and the quantity and quality of resources available to future generations, in a way the resource usage rates are set so that future generations are not jeopardized\textsuperscript{12}.

### 3.5. The Circular Economy System

Circular Economy is the science that rethinks economic practices. Its importance lies in pointing out solutions that seek to lessen the human impact on the environment. The object of Circular Economy is turn waste into economic input, in order to obtain new raw materials, in a circular productive system. This process is wholly connected to sustainable development, since its goal is to balance out renewable resources in a rational usage of these same resources.

According to a report by the Ellen MacArthur Foundation, the opportunities of Circular Economy are also present in urban environments. In this sense, the city would possess a
multi modal mobility system, with shared public transport. Lastly, a mean for individual transportation would be offered. The emergences of sharing platforms show that circular models of value creation already exist in sectors of the economy\textsuperscript{14}.

One essential characteristic of the Circular Economy is its regenerative and restorative nature, therefore, material science and its selection perform a critical role in product design. For the process to be successful it is necessary that the design incorporates features such as the use parts designed for durability and ease of classification, possibility for the separation or re-utilization of components or raw materials in the end of the product's life, as well a fabrication criteria that takes possible applications of sub-products and residue into account. Accordingly, education can perform an important role in the training of future professional for a new economic paradigm, particularly through the creation of a foundation of skills for promoting circular innovation\textsuperscript{14-15}.

4. 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\textsuperscript{16}. 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 do Vale and therefore, based on the diagnosis, the Ciclo Camp Project can be implemented in the Campus do Vale of the Universidade Federal do 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.

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 Campus do Vale, 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.

5. Discussion and Results

Through the identification of the public that answered the survey, it was determined that it is in large part constituted by students who are present at the Campus do Vale more
than once a week, with classes spread over more than one shift, prioritizing the morning shift, and that they use public transportation as their means of locomotion to arrive at the Campus. It is worth noting that over half of those interviewed reside in the Porto Alegre metropolitan region and that for over 20% of the students, there are no means of public transportation available going through the central part of the Campus do Vale. Based on the analysis of the answers obtained in the study, it is possible to conclude that 60% of those interviewed experienced delays during class hours due to the distance between the main points of the Campus do Vale, and that a little bit over 70% were prevented from having lunch or dinner at the University Restaurant (UR) due to the distance between the UR and the classrooms. For over 80% of the sample there is confirmation of the need to offer other methods of travel inside the Campus, with the same amount of survey takers claiming they would use bicycles in routes that saved time. For practically 100% of those interviewed, using bicycles is considered a clean and physical condition enhancing mode of transport. Over 80% would accept paying a symbolic sum for utilization and maintenance of the bicycle lease service and practically 82% would consent to installing a cellphone application which provided information about the service.

Based on the diagnosis, it is possible to confirm the need to implement the Ciclo Camp Project in the Campus do Vale of the Universidade Federal do Rio Grande do Sul. The institution is a potential laboratory for the transition to the circular economy, enabling professors 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.

5. Conclusions

After concluding the analysis of the results, an action plan was put in place based on Golden Circle, a concept developed by the leadership specialist Simon Sinek which intends to create and develop the value of new ideas through a simple methodology. Figure 2 shows a summary of the actions proposed to UFRGS in order to improve the aspects of internal mobility within the Campus do Vale through the Ciclo Camp Project.

Why? It is a clean mode of transportation offered as an alternative to those already available at the Campus do Vale, which challenges the students and professors to get involved
with the goal of sustainability. Ciclo Camp Project intends to aggregate motivations of students from the many Engineering courses with the professors' technical knowledge to facilitate the daily life of the UFRGS community.

How? By promoting wellbeing and facilitating travel inside the Campus do Vale in a quick and effective way, connecting technology to green ideals of diminishing harmful environmental impacts.

What? Through the rental of bicycles to active students and staff on the institution, with the usage of a cellphone app and conditional on the payment of a symbolic sum each semester. The starting project will provide three stops at the main points of the Campus do Vale, those with the biggest transit flow, as well as front baskets and nighttime lights on the bicycles.

Based on the diagnosis, it is possible to confirm the need for implementation of the Ciclo Camp Project at the Universidade Federal do Rio Grande do Sul Campus do Vale. The Circular Economy model used in this work brings with it the perspective the perspective of manufacturing the components for the bicycles and collection points out of scrap metal coming from the University itself. The institution is a potential laboratory for the transition towards a Circular Economy, allowing students and faculty to obtain knowledge and put in practice what is taught in the classroom. As such, in re-utilizing metallic materials otherwise destined for disposal lies a challenge as well as an opportunity to become aligned to an environmentally restorative and regenerative economy.

The difficulty in finding a larger amount of up to date bibliography on the topic of sustainable alternative means of transportation can be cited as a limitation of this research. Regarding studies about the manufacture of bicycles using waste material, the realization of an in-depth research on new methods of fabrication for bicycles out of plastic residue, cellulose and bamboo is suggested.

Reference