Research, Society and Development, v. 9, n. 9, e429996915, 2020
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v9i9.6915

Vegetação e defesa natural do solo: um experimento com alunos da educação básica

Vegetation and soil natural defense: an experiment with students of basic education

Vegetación y defensa natural del suelo: un experimento con estudiantes de educación básica

Received: 20/07/2020 | Reviewed: 13/08/2020 | Accept: 19/08/2020 | Published: 23/08/2020

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Resumo

Este artigo descreve as ações realizadas no Plano de Desenvolvimento da escola municipal Domingos Gonçalves Gomes, no município de Campo Grande-MS. O objetivo foi analisar a importância da vegetação na interceptação das chuvas de uma amostra de Inga Fagifolia (uma árvore popularmente conhecida como ingazeiro), buscando uma aproximação entre a pesquisa científica e os alunos do ensino fundamental. Para isso, foi realizado o monitoramento da chuva por meio de pluviômetro digital e pluviômetro analógico, feito à mão pelos próprios alunos. Monitorar as taxas de interceptação de chuva pela vegetação permitiu novas discussões em sala de aula pautadas nos conceitos fundantes da Geografia, sobretudo de Paisagem. Esta pesquisa ocorreu durante o outono de 2017 e foi elaborada com alunos do 9º ano do Ensino Fundamental. Os resultados apontaram para a eficácia da utilização de pluviômetros artesanais, fabricados com garrafas PET (dois litros), durante o monitoramento das chuvas e indicaram que o exemplar do Ingazeiro pode reter até 86,67% das chuvas. Os alunos perceberam a importância da vegetação para a proteção do solo e a importância da pesquisa científica para a geração de dados que auxiliem no planejamento e gestão ambiental. Por fim, espera-se que este projeto seja mantido, motivando mais alunos a estudar por meio de atividades práticas de educação ambiental.

Palavras-chave: Interceptação de chuvas; Vegetação; Ensino Fundamental; Educação ambiental.

Abstract

This article describes actions performed in the Development Plan of the municipal school Domingos Gonçalves Gomes, in the city of Campo Grande-MS. The aim was to analyze the importance of vegetation on rainfall interception from a sample of Inga Fagifolia (a tree popularly known as ingazeiro), searching an approximation between scientific research and students of basic education. For this, a rainfall monitoring was performed by means of digital rain gauge and handmade analogue rain gauges – made by the students themselves. Monitoring the rates of rainfall interception by vegetation allowed new discussions in the classroom based on the fundamental concepts of Geography, especially Landscape. This research took place during the autumn of 2017 and was elaborated by the students of the 9th grade of Elementary School. The findings pointed out to the effectiveness of the use of handmade rain gauges, manufactured with PET bottles (two liters), during the rainfall monitoring and indicated that the Ingazeiro specimen can retain up to 86.67% of rainfall. The students realized the importance of vegetation for the soil protection and the importance of scientific research for generation data that will help with planning and environmental management. Finally, we expect that this project will be maintained, motivating more students to study through practical environmental education activities.

Keywords: Rainfall interception; Vegetation; Elementary Education; Environmental education.

Resumen

Este artículo describe las acciones realizadas en el Plan de Desarrollo de la escuela municipal Domingos Gonçalves Gomes, en la ciudad de Campo Grande-MS. El objetivo fue analizar la importancia de la vegetación en la interceptación de lluvias a partir de una muestra de Inga Fagifolia (árbol conocido popularmente como ingazeiro), buscando un acercamiento a la investigación científica en los alumnos de educación básica. Para ello, se realizó un seguimiento de las precipitaciones mediante pluviómetro digital y pluviómetros analógicos artesanales, realizados por los propios alumnos. El seguimiento de las tasas de intercepción de lluvias por la vegetación permitió nuevas discusiones en el aula basadas en los conceptos fundamentales de la Geografía, especialmente el Paisaje. Esta investigación se llevó a cabo durante el otoño de 2017 y fue elaborada por los alumnos de 9º de Primaria. Los resultados

señalaron la efectividad del uso de pluviómetros artesanales, fabricados con botellas de PET (dos litros) durante el monitoreo de lluvia, e indicaron que el espécimen de Ingazeiro puede retener hasta un 86,67% de la lluvia. Los estudiantes se dieron cuenta de la importancia de la vegetación para la protección del suelo y la importancia de la investigación científica para la generación de datos que ayudarán con la planificación y la gestión ambiental. Finalmente, esperamos que este proyecto siga motivando a más alumnos a estudiar a través de actividades prácticas de educación ambiental.

Palabras clave: Intercepción de lluvias; Vegetación; Educación elemental; Educación ambiental.

1. Introduction

Raindrop impact provokes the soil particle breakdown and is mainly responsible for water erosion. The runoff, part of this process, begins when the rain intensity is greater than the infiltration rate and soil absorption. At that stage, the materials disaggregated by the raindrop impact are carried to lower relief areas.

In this context, vegetation plays an essential function as it acts as the soil natural protection, reducing the rainfall kinetic energy and the surface runoff speed. Among the purposes of the vegetation cover, we can highlight the rainwater interception through the canopy of the trees; as soon as the interception occurs, part of the water is evaporated from the canopies, part reaches the soil directly, part flows through the trunk and part drips through the canopy (Cabanêz, FerrarI, Paula, & Cabanêz, 2011), reducing the raindrop impact on the soil and, consequently, the particle disintegration.

Taking this into consideration, this study aimed to bring the students of the municipal school Domingos Gonçalves Gomes, in the city of Campo Grande-MS, closer to the scientific research process. The research, in accordance with scientific principle, was conducted with elementary school students and proposed an analysis of the importance of vegetation cover on rainfall interception, using as reference a sample of Inga Fagifolia.

We believe that the activity impels the development of new research practices and opens up more space for environmental education at school.

We hope that these actions will be added to other activities. The school environment, according to Medeiros, Mendonça, Sousa, & Oliveira (2011), can guarantee the practice of citizenship, because, at school, students have the opportunity to express themselves as members of a society, demonstrating the self-awareness about their rights and duties and

expressing their opinions. We still believe that scientific research, as an investigative tool and critical observing a problem, in one context, can contribute to building a citizen-student,

We also believe that environmental education makes it possible to understand the responsibilities of each citizen for care of the environment and generates means to develop a conscious and ecological attitude in each individual.

According to Art. 2 of Resolution No. 2 on June 15, 2012, which established the National Curricular Guidelines for environmental education, this is "a dimension of education, it is intentional activity of social practice" and should, therefore, allow the students to develop "a social character in their relationship with nature and with other human beings" (Resolução 02, de 15 de junho de 2012, 2012).

In accordance with the guideline and in line with our view, through environmental education, students can improve their activities, becoming an ethical and social practice with environmental responsibility.

Ferreira & Santos (2012) says that environmental education should awake in the students the awareness of preservation and citizenship. The human being must understand from an early age that it is necessary to preserve and take care of nature, and that the future depends on the balance between Man and Nature, as well as the rational use of natural resources. The environment inhabited by the human beings must be in balance with the place where they live.

Through the development of projects that bring the student closer to the reality and the applicability of contents learned in the classroom, teachers can lead their students to become aware of the social and economic relationship that were constructed by Humanity, helping them understand that natural resources are finite. According to the Geography National Curriculum Parameter, it is essential "that the teacher creates and plans learning situations in which students can know how to use the procedures of geographical studies".

Therefore, the process of knowledge construction about the different types of landscape goes through fundamental stages of learning, such as observation, description, analogy and synthesis. These stages are important procedures that can be practiced by students together with the teacher, offering better possibilities for a quality education.

This activity had as object of study the soil protection, which involves both work with aspects of geography and environmental education. The students assumed that soil protection tends to be more effective when it is associated with some type of vegetation cover.

The presence of vegetation cover is essential for the structure and stability of the soil, as vegetation acts as a buffering system for rainwater particles, and it reduces the energy

when these particles reach the soil, which minimizes the raindrop impacts (called splash effect) and prevents the formation of erosive processes.

Thus, we recognize the importance of monitoring the rainfall interception rates by vegetation, which should be used as a resource for environmental degradation studies.

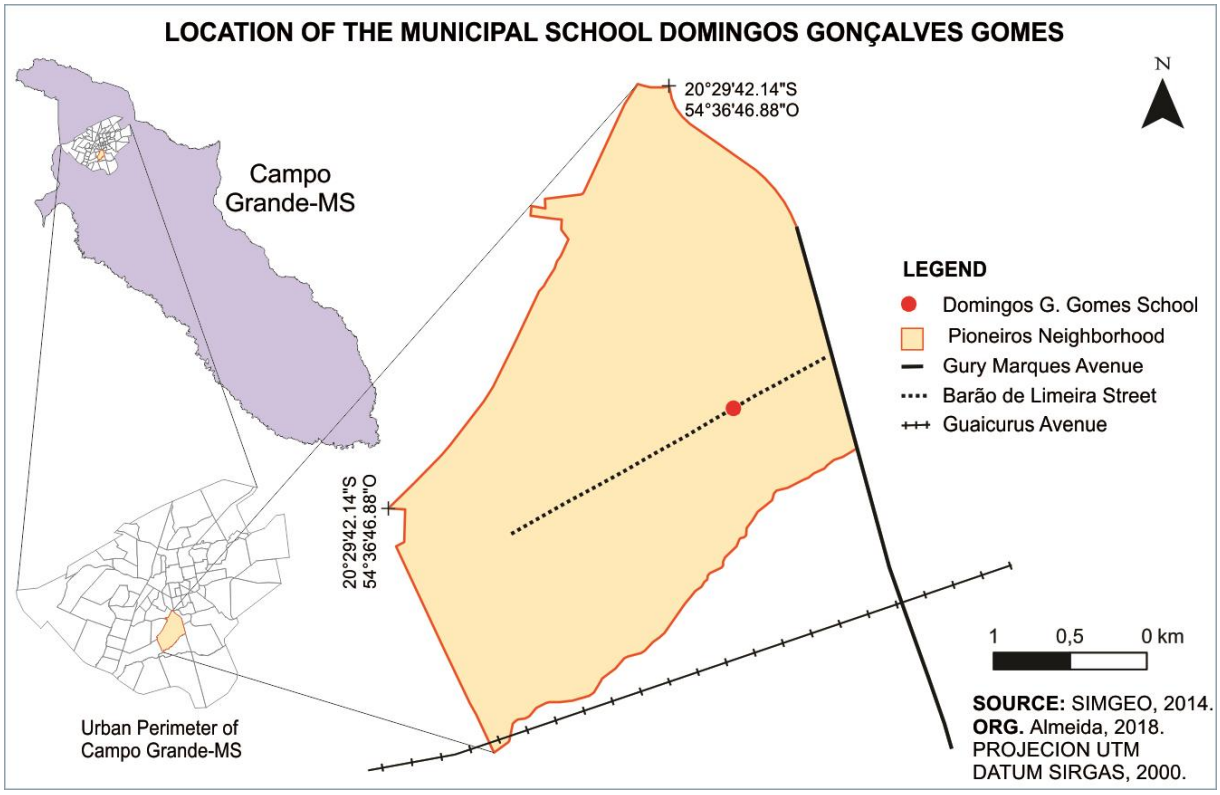
This research at municipal school Domingos Gonçalves Gomes is pioneer because it brought scientific research activities and elementary school closer together, specifically the 9th grade students.

Considering that the students who took part in the study in 2017, from 2018 on they will move to a new education cycle, and they will be able to attend educational institutions such as Federal Institutes and technical secondary schools.

The project was performed within the actions of the school Development Plan with the purpose of stimulating and making the students aware of the learning activities and the relevance of the school and the studies in the daily life of all citizens.

The municipal school Domingos Gonçalves Gomes is located in the center-southern part of the city of Campo Grande-MS, Pioneiros neighborhood (Figure 1).

Figure 1. Localization map of the municipal school Domingos Gonçalves Gomes, in Pioneiro neighborhood, Greater Campo Grande-MS.



Source: The authors.

The neighborhood presents socioeconomic diversity and, as a result, the school public is also quite heterogeneous. According to Brazilian Institute of Geography and Statistics (IBGE), in 2010, Pioneiros neighborhood had 16,417 inhabitants, representing approximately 8% of the total population of Campo Grande-MS. The per capita income of Pioneiros neighborhood is R$ 630,06 and most of the population has an average monthly income around one and two minimum wages, and is largely proceeding from activities related to the second and third sectors of the national economy.

The literacy rate is 95.07%, in this respect, Domingos Gonçalves Gomes school has a key role, as it aims to offer quality education, by valuing participation and transparency. The school opened on August 20, 1978 and currently serves about 900 students.

2. Methodology

This is an experimental study and it is characterized by a quali-quantitative approach, whereas the data were collected in numbers and later converted into information. The data presented here were collected through monitoring, during the autumn of 2017.

It features them an exploratory research allowing the validation of the effectiveness use of a new teaching methodology, which is based on: autonomous learning (Freire, P., 2016), project pedagogy, problem solving (Pereira, et al. 2018) and investigative teaching (Carvalho, 2013). The quantitative character of the research occurred in the systematic monitoring of the rains and in the tabulation of these data for analysis in basic statistics (average, median and standard deviation), used in the classroom discussions and enabled the other analysis, which were of a qualitative nature as analysis of meaningful learning.

To achieve the objective of the research, some steps were proposed throughout the study: a) to monitor rainfall during the autumn of 2017 (from March 20 to June 21); b) to compare outcomes between two handmade rain gauges placed in different locations; c) to estimate water interception by means of the ingazeiro specimen; and d) to hold discussions in the classroom involving procedures of observation, registration procedures, description, documentation, representation and environmental phenomena research that make up the landscape and geographical space.

The data collection was organized from a digital wireless rain gauge (Figure 2-a), model 4760, Incoterm brand, installed at a fixed point (coordinates 20° 30 ' 50.93 "S and 54° 36 ' 31.98"), at 1.5 meter high, without interference from vegetation and/or construction, according to the guidelines provided by the manufacturer. This equipment was used as basis

for sample validation collected in two handmade rain gauges (manufactured with PET bottles) and installed in strategical points.

The first handmade rain gauge was installed in the space set aside for the project "Horta da Escola" ("School Vegetable-Garden"), at coordinates 20° 30 ' 51.67 "S and 54° 36 ' 31.56 W"-for organization purposes, the rain gauge was titled "Horta" (Figure 2-b). The second handmade rain gauge was installed in the school parking area at coordinates 20 ° 30'51.67 "S and 54 ° 36'31.56" W, under Ingá-Fagifolia, a tree popularly known in the state of Mato Grosso do Sul as Ingazeiro - this rain gauge was titled "Ingá" (Figure 2 - c).

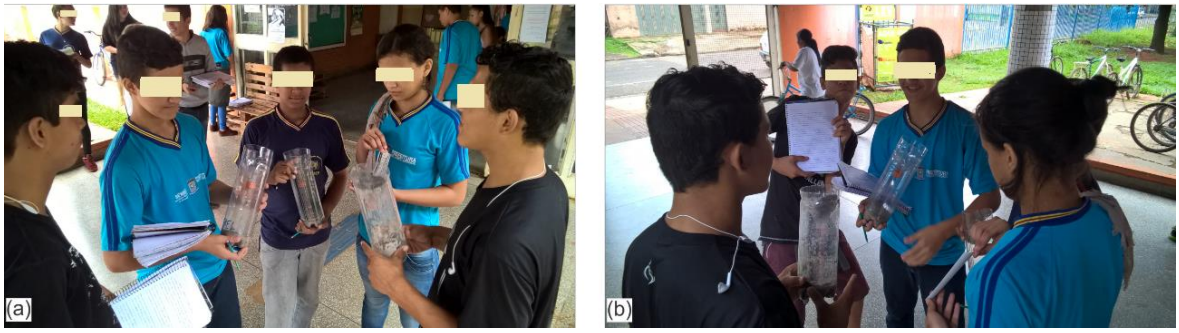
Figure 2. A) Digital rain gauge collector installed at the municipal school Domingos Gonçalves Gomes. B) Students monitoring a handmade rain gauge. C) Handmade rain gauge installed under the ingazeiro.

Source: The authors.

The handmade rain gauges were built and installed by 25 students who were involved in the project. All of them attended the 9th grade at municipal school Domingos Gonçalves Gomes, in the city of Campo Grande-MS.

The students were organized into groups of five people, and they were supposed to build their own rain gauge using PET bottles (two liters) and waterproof past (cement and sand). The millimeter graduated ruler was made based on the Civil Defense rule and printed on plastic adhesive (Figure. 3, a-b).

Figure 3. The images show the students studying about the rain gauge. The discussions took place outdoors (outside of the traditional classroom) to provide a playful learning experience.



Source: The authors.

The students read the rain gauges every day, from 7:00 AM to 8:00 AM, during the autumn of 2017. They were also responsible for monitoring, with the systematic follow-up of the teacher for the data maintenance and validation whenever necessary.

At the end of the data collection, they were tabulated and analyzed. Subsequently, experiment outcome was presented in a dynamic class. At this stage, the students were able to point out the quality of a class where they produce the results themselves, and also indicate their perspectives for new practical activities of monitoring and environmental education.

3. Results e Discussion

The results obtained by monitoring rainfall as well as qualitative analyzes (meaningful learning through investigative teaching) are presented in this topic, however, for a better description, these results are divided into two topics, namely: The rainfall volume and the interception rate by vegetation and Perspective of the Involved Students and Culmination of the Project.

3.1 The Rainfall Volume and the Interception Rate by Vegetation (Ingazeiro)

It is worth noting the commitment and curiosity that the students maintained during the research. In this way, the records followed the common protocols such as taking notes at specific time and at the same spreadsheet (ZAVATTINI & BOIN, 2013). The data was reviewed and discussed weekly considering the digital pluviometer as a leveling base.

The monitoring conducted by the students recorded 24 rain events during the autumn of 2017 at municipal school Domingos Gonçalves Gomes, in the city of Campo Grande-MS

(Table 1).

Table 1. Comparison between the Rainfall Rates Recorded in the Three Installed Rain Gauges.

DATE	DIGITAL 24 HOURS	VEGETABLE-GARDEN REGISTER	DIFFERENCE (%)	INGÁ REGISTER	INTERCEPTION (%)
23/3	3,10	2,8	9,68	1,2	61,29
25/3	26,70	25,5	4,49	23,2	13,11
26/3	4,70	4,3	8,51	1,4	67,44
27/3	9,20	8,5	7,61	7,2	21,74
2/4	3,60	3,4	5,56	1,2	64,71
6/4	18,90	17,5	7,41	15,8	16,40
9/4	5,40	5	7,41	4,6	8,00
10/4	7,20	6,5	9,72	5,7	12,31
11/4	**1,30**	**1,2**	7,69	0,9	25,00
15/4	10,70	10	6,54	9,6	**4,00**
16/4	18,70	17,7	5,35	15,4	12,99
17/4	7,20	7	2,78	6,3	10,00
20/4	**59,40**	**53,5**	**9,93**	36,7	31,40
21/4	15,60	14,6	6,41	13,5	7,53
22/4	21,30	21	1,41	18,2	13,33
27/4	7,60	7,2	5,26	6,3	12,50
28/4	8,20	7,5	8,54	6,8	9,33
29/4	21,90	22	0,46	18,3	16,82
30/4	48,70	44,2	9,24	34,1	22,85
22/5	4,50	4,9	8,89	2,3	53,06
24/5	5,80	5,3	8,62	4,5	15,09
9/6	25,20	25	**0,79**	22,8	8,80
11/6	1,40	1,5	7,14	0,2	**86,67**
12/6	4,10	3,9	4,88	1,9	51,28
TOTAL	**340,40**	**320,00**	**5,99%**	**258,10**	**19,34**

Source: The authors.

The digital rain gauge recorded a total of 340,4 mm, while the rain gauge of the vegetable-garden recorded a total of 320 mm, with a difference of 5,99%. Considering isolate results, the big difference was 9,93%.

This indicates that, for academic research purpose and mainly for environmental education and scientific research initiation, the use of handmade gauges can be a feasible option, as it provides good results (difference below 10%) at a low cost.

The rain gauge of the ingazeiro recorded 258,10 mm of rain, concluding that it had aproximatelly 19.34% of rainfall volume interception, when compared with the rain gauge of the vegetable-garden.

Concerning the rain gauge installed under the vegetation (ingazeiro), the data collected indicated water retention between 4% and 86.67%. In this case, we can notice a wide variation, which can be explained by rainfall rates grouped and associated to the interception average (Table 2).

Table 2. Comparison of rainfall rate and average vegetation interception (inga fagifolia) in grouped data.

CLASS (mm)	Number of Events	Difference between digital rain gauge and the vegetable-garden rain gauge (%)	AVERAGE INTERCEPTION (%)
< 5	7	< 10	**58,49**
5 – 10	7	> 10	12,71
10 – 20	4	< 8	10,23
20 – 30	4	< 5	**13,2**
30 – 40	0	0	0
40 – 50	1	> 10	22,85
> 10	1	> 10	**31,4**

Source: The authors.

The average interception tends to be higher with rainfall below 5 mm (58.49%) and follows a descending order until it reaches 20 mm rainfalls. From that point on, the tendency changes, showing higher rainfall interception values in rainfalls with higher volumes (up to 20 mm). In the study, this could be observed in relation to the rainfall volumes that exceeded 40 mm. However, during the experiment, only one event was registered within this class, making a detailed and safe analysis of such change more difficult.

The experiment conducted by the students of the 9th grade of the municipal school Domingos Gonçalves Gomes showed that research activities can be performed on basic education and the results can serve as a basis for awareness of other classes as the relevance of vegetation cover in natural, rural and urban environments.

3.2 Perspective of the Involved Students and Culmination of the Project

New questions and new readings came up in the classroom after the end of the experiment. It was noted that not all students took part in the discussions, however, most of them showed interest and good participation in data collection and in the discussion of results.

During the collections, the students inquired about the difference of precipitation across the city, which allowed a discussion about the irregular rainfall distribution. In addition, the students also questioned the fact that vegetation retains rainwater, taking to the approach of associated topics such as deforestation and soil erosion.

Considering the classroom dynamics, it is worth adding that learning is more meaningful when there is connection between the daily life issues and the questions promoted by the content studied. Therefore, an investigative teaching approach can provoke curiosity in the student, allowing them to reflect on the knowledge construction process.**Erro! Fonte de referência não encontrada.**

These research outcomes (interception and data rainfall) were presented at the Science and Technology Fair of the Instituto Federal de Mato Grosso do Sul-IFMS, which took place from 16 to 21 October 2017. Two students who were involved in the project volunteered to take charge of the exhibition, and their attitude motivated other students to participate in the event which promoted scientific knowledge at various levels of education.

New projects are being developed and the highlight is for a surface runoff simulator, which can serve as a base for classes that need to show, in practice, the importance of vegetation cover on soil erosion control.

We can note that many students, after knowing the research methods and realizing the advantages of a practical study, aim to enroll in high schools that value scientific research.

4. Final Considerations

The development of an environmental education project guided by practical activities is considered a great option to attract the students' attention to discuss the relevance of the conservation of natural environments, as well as for the altered environment restructuring.

Throughout this project, the 9th grade students of the elementary school collected data relevant to the school through simple, low-cost tools (handmade rain gauge) and were able to prove, through comparison with a digital rain gauge, that the data were relatively close (maximum difference of 10%).

Rainfall interception rates for the ingazeiro specimen served for the students to understand the valorization of the vegetation cover and increased the knowledge of the necessity of preserving the forests which can act as soil stabilization agents.

The practical activities of this project culminated with the students participating in Science and Technology Fair at the Instituto Federal do Mato Grosso do Sul-IFMS and encouraged new environmental education projects through practical activities.

We started a new project to create one surface runoff simulator that will contribute to geography classes and environmental awareness. Besides that, the use of the surface runoff simulator will reinforce the notes made here, specially regarding the importance of vegetation cover.

Finally, we hope to continue research activities involving the students of the municipal school Domingos Gonçalves Gomes, with an interdisciplinary perspective, always revealing the relevance of scientific research in the data generation that will be able to add to planning and environmental management. The project maintenance and other activities can motivate

the students to study and perform environmental education practices supported by investigative teaching and meaningful learning.

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