UFSM

CIÊNCIA e NATURA

ISSN 2179-460X
OPEN ACCESS

Ci.e Nat., Santa Maria, v. 45, spe. n. 1, e84153, p. 01-06, 2023 • https://doi.org/10.5902/2179460X84153
Submitted: 18/06/2023 • Approved: 04/07/2023 • Published: 02/10/2023

Special edition

Mock-up as a teaching resource for teaching wind energy

Maquete como recurso didático para o ensino de energia eólica

Marianna Batista Teixeira[I], Cleiton Anderson Trindade de Carvalho[I], Bárbara Garcia de Paiva Moraes[I], Silvana Maldaner[II], Jocenir Boita[I], Lucinéia Fabris[I], Glauber Rodrigues de Quadros[I]

[I] Universidade Federal de Santa Maria, RS, Brasil
[II] Colégio Técnico Industrial de Santa Maria, Departamento de Ensino, Santa Maria, RS, Brasil

ABSTRACT

The unbridled consumption of energy in modern society has motivated the growth and search for renewable energies in modern society has motivated the growth and search for renewable energies. Among the various forms of clean energy generation, one of the forms has gained prominence on the world scene: wind energy. The use of energy from the wind is not recent, in antiquity, this form of energy was already used in windmills. Recently, wind energy has gained space on the world stage due to the search for replacing fossil fuels with clean energy. The students of the Mechanical Engineering and Electrical Engineering courses at Universidade Federal de Santa Maria – Campus Cachoeira do Sul (UFSM-CS) developed a proposal for teaching Physics based on the construction of a MOCK-UP with a wind energy generation system due to the importance of this form of renewable energy generation. The wind power generation educational mock-up was presented at the 1st Science, Technology and Innovation Fair at UFSM-CS.

Keywords: Wind Energy; Teaching; Physics

RESUMO

O consumo desenfreado de energia na sociedade moderna tem motivado o crescimento e a busca por energias renováveis. Dentre as diversas formas de geração de energia limpa, uma delas tem ganhado destaque no cenário mundial: a energia eólica. O uso da energia proveniente dos ventos não é recente. Já na antiguidade, essa forma de energia era empregada nos moinhos de vento. Recentemente, com a busca pela substituição dos combustíveis fósseis, a energia eólica ganhou espaço no cenário mundial. Devido à importância dessa forma de geração de energia, alguns alunos dos cursos de Engenharia Mecânica e de Engenharia Elétrica, da Universidade Federal de Santa Maria – Campus Cachoeira do Sul (UFSM-CS), desenvolveram uma proposta de ensino de Física baseada na construção de uma maquete com um sistema de geração de energia eólica. Essa maquete foi apresentada na 1ª Feira de Ciências, Tecnologia e Inovação da UFSM-CS.

Palavras-chave: Energia Eólica; Ensino; Física

1 INTRODUCTION

In Brazil, basic education is divided into early childhood education, primary education and secondary education (Brasil, 1996). In this separation, Physics as the content of a discipline exists from the first year of secondary education. On the other hand, in elementary school, there is the discipline of Science, but in this discipline, themes associated with Physics are not always addressed and when this occurs, most of the time, teachers do not have training in teaching Physics (Costantin Júnior, 2017). At the same time, in recent years, the movement to include science in the first years of elementary school has grown (Santos; Linhares, 2019). Several studies point out that a way to add science in the early years of elementary school is through the use of educational mock-ups. According to Santos e Linhares (2019), the use of mock-ups in teaching facilitates the understanding of the contents studied, in addition to allowing a rapprochement between students and teachers. Considering this fact and seeking an innovative methodology for teaching energy in science classes, this paper presents an approach to teaching science/physics using a mock-up to study wind energy generation.

2 MATERIALS AND METHODS

Renewable energies and production processes are important subjects that should be studied in schools in the early years of elementary school. Thus, a group of students from the Mechanical Engineering and Electrical Engineering courses at the Federal University of Santa Maria - Cachoeira do Sul campus decided to create an educational facility with a mini wind turbine connected to a residential lighting system. The idea of the project was to develop low-cost mock-ups that would enhance the teaching of energy generation and the processes involved.

In the elaboration of the mock-ups, several easily acquired materials and tools were used. To make things easier, the materials used were separated into four groups: construction, house construction and the rotor, the electrical part of the mock-up and

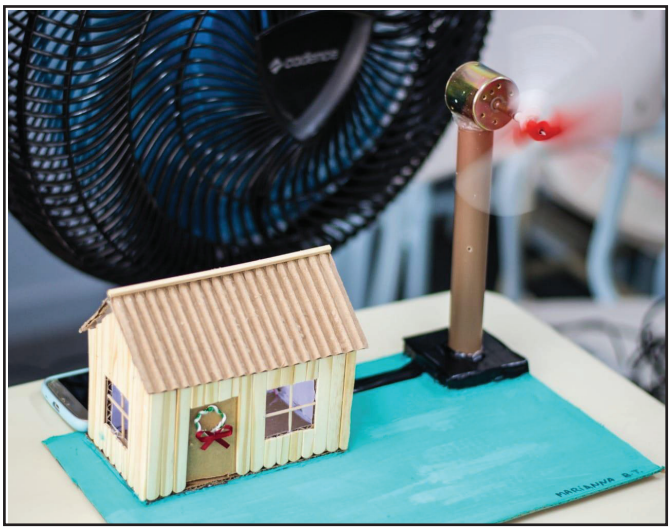
tools. In the construction of the little house, 2 cardboard rectangles (16cm x 7cm), 2 cardboard rectangles (14cm x 8cm), 2 cardboard rectangles (12cm x 9cm), approximately 100 popsicle sticks, 3 pieces of acetate (4cm x 4cm) were used, 1 barbecue stick, cardboard (40cm x 40cm). To build the rotor, a toy drone propeller, a piece of PVC pipe and insulating tape were used. For the electrical part of the mock-up, high-brightness white LEDs, a DC motor, 12V, 6W, 4400 rpm, electronic connection wires, a multimeter and a domestic fan (to drive the turbine rotor) were used. As a working tool, a stylus, a ruler, hot glue, super glue, a permanent marker and a protractor can be mentioned.

3 RESULTS AND DISCUSSION

In terms of electricity generation, Brazil occupies 8th place in the ranking of countries with the highest wind capacity, being the first in South America (Associação Brasileira De Energia Eólica, 2018). This ranking could be even better with regard to energy generation, especially if decentralized energy systems were employed through the use of small wind turbines. These small wind turbines could be an alternative for the development of wind energy decentralization systems and, consequently, for smaller-scale generation and domestic use. In this context, understanding such systems and the energy transformations involved in such processes is of fundamental importance. Thinking about it, in this work a model was elaborated with a mini horizontal axis wind turbine applied to the lighting of a small house. For this, a small DC motor, a LED and cardboard sheets were used to build the model. A detailed list of materials used in the construction was presented in section 2. To make the rotor of the wind turbine rotate, a domestic fan was used and with the movement of the rotor blades, the little house in the model is illuminated. Figure 1 presents the wind power generation educational mock-up.

The functioning and construction of the mock-up. include classic Physics content. Among the contents that can be discussed with the transversal theme of wind energy, mechanical energy, kinetic energy, movement of air masses and electricity can be mentioned (Silva; Venite; Silva; Fonseca Filho, 2018).

Figure 1 – Wind power generation educational mock-up



Source: Authors (2023)

4 CONCLUSIONS

The wind power generation educational mock-up, designed and exhibited at the 1st Science, Technology and Innovation Fair - UFSM-CS, allowed for the presentation and discussion of operation of wind turbines through the contents of Physics. In addition, the use of mock-up in the teaching of transversal themes makes the teaching of Physics more connected to the evolution of modern society, allowing the study of electricity topics in a simple and attractive way.

ACKNOWLEDGMENTS

The study also has been partially supported by brazilian funding agencies CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico), grant nº 407643/2021-4 and FAPERGS (Fundação de Amparo à Pesquisa do Estado do RS).

REFERENCES

ASSOCIAÇÃO BRASILEIRA DE ENERGIA EÓLICA. ABEEÓLICA. **Boletim Anual de Geração Eólica 2017**. São Paulo: Associação Brasileira de Energia Eólica, 2018. Disponível em: https://www.abeeolica.org.br/wp-content/uploads/2018/04/Boletim-Anual-de-Geracao-2017.pdf. Acesso em: 22 fev. 2023.

BRASIL. **Lei nº 9.394, de 20 de dezembro de 1996**. Estabelece as diretrizes e bases da educação nacional. Brasília, DF: Presidência da República, 1996. Disponível em: https://www.planalto.gov.br/ccivil_03/leis/L9394compilado.htm. Acesso em: 20 maio 2023.

CONSTANTIN JÚNIOR, B. F. **A Física no Ensino Fundamental: onde estamos?**. 2017. Trabalho de Conclusão de Curso (Licenciatura em Física) - Universidade Federal de Uberlândia, Uberlândia, 2017. Disponível em: https://repositorio.ufu.br/bitstream/123456789/26349/1/A%20Física%20no%20Ensino%20Fundamental_%20onde%20estamos.pdf. Acesso em: 22 fev, 2023.

SANTOS, F. J. O. dos; LINHARES, J. C. S. O uso de maquetes no estudo das ciências nas séries iniciais do ensino fundamental. *In*: VI CONGRESSO NACIONAL DE EDUCAÇÃO (CONEDU). **Anais** [...]. Campina Grande: Realize Editora, 2019. Disponível em: https://www.editorarealize.com.br/index.php/artigo/visualizar/61741. Acesso em: 10 jan. 2023.

SILVA, S. R. C.; VENITE, K. K. C.; SILVA, E. M. da; FONSECA FILHO, I. C. da. Transformação de energia e meio ambiente: interdisciplinaridade no ensino de física. *In*: V CONGRESSO NACIONAL DE EDUCAÇÃO (CONEDU). **Anais** [...]. Campina Grande: Realize Editora, 2018. Disponível em: https://editorarealize.com.br/artigo/visualizar/49130. Acesso em: 24 abr. 2023.

Authorship contribution

1 – Marianna Batista Teixeira

Degree in progress in Electrical Engineering
https://orcid.org/0009-0006-8354-8443 • marianna.teixeira@acad.ufsm
Contribution: writing and preparation of the work

2 – Cleiton Anderson Trindade de Carvalho

Degree in progress in Electrical Engineering
https://orcid.org/0000-0002-4754-0720 • cleiton.trindade@acad.ufsm.br
Contribution: writing and preparation of the work

3 – Barbara Garcia de Paiva Moraes

Degree in progress in Mechanical Engineering
https://orcid.org/0009-0006-5675-636X • babygm@hotmail.com
Contribution: writing and preparation of the work

4 – Silvana Maldaner

Physics, PhD in Physics
https://orcid.org/0000-0001-9060-4614 • silvana.maldaner@ufsm.br
Contribution: writing and preparation of the work

5 – Jocenir Boita

Physicist, PhD in Physics
https://orcid.org/0000-0002-1433-3610•jocenir.boita@ufsm.br
Contribution: writing and preparation of the work

6 – Lucinéia Fabris

Mathematics, PhD in Mathematics
https://orcid.org/0000-0003-0581-5586•lucineia.fabris@ufsm.br
Contribution: writing and preparation of the work

7 – Glauber Rodrigues de Quadros

Mathematics, PhD in Mathematics
https://orcid.org/0000-0002-6182-7525 •glauber.quadros@ufsm.br
Contribution: writing and preparation of the work

How to quote this article

TEIXEIRA, M. B.; CARVALHO, C. A. T. de; MORAES, B. G. de P.; MALDANER, S.; BOITA, J.; FABRIS, L.; QUADROS, G. R. Mock-up as a teaching resource for teaching wind energy. **Ciência e Natura**, Santa Maria, v. 45, spe. n. 1, e84153, 2023. DOI: https://doi.org/10.5902/217946084153. Available in: https://periodicos.ufsm.br/cienciaenatura/article/view/84153. Accessed in: em: day month abbr. year.