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Experimental Activity on the Photovoltaic Effect

Authors : Salomão Manuel Francisco, Manuel António Salgueiro Da Silva, Bento Filipe Barreiras Pinto Cavadas, Teresa Monteiro Seixas

Abstract : In bachelor's degrees in Physics Education framework in Angola, and to a certain extent, within the community of Portuguese language countries (CPLP), teaching methodologies rely heavily on theoretical memorization and mathematical demonstrations. This approach often discourages students, particularly the female population, as the reliance on theoretical mathematical demonstrations generates the perception of Physics as an arduous, challenging discipline. To address this challenge and recognize the value of practical application as an evaluative criterion of material truth, we propose a practical activity in Environmental Physics that will be shared with Angolan higher education teachers, who will receive full scaffolding and support from the authors. These teachers, adopting and developing similar activities in a classroom setting, will contribute to the environmental education framework as well. Additionally, this work aligns with different goals of UNESCO's 2030 agenda, namely, specifically, goals 4, 5, 7, 11, 13, and 17. The experimental activity developed in this work is centered around the demonstration of the photovoltaic effect and its application for renewable energy production. The first objective of the activity is to study the variation of electrical power supplied by a photovoltaic system (PV) to an electrical circuit as the angle of light incidence changes. Students can observe that the power supplied to the circuit is greater when light rays fall perpendicularly on the PV. However, as the angle of incidence increases, resulting in a larger area covered by the light rays, the power supplied to the circuit decreases due to lower irradiance. The second objective is to demonstrate that the power output can be maximized by adjusting the circuit load resistance at each irradiance value. In these two parts of the activity, students can analyze experimental data taking into account the irradiance law and the equivalent circuit description of a PV cell. Through detailed data analysis, students are also expected to assess the effects of temperature on PV efficiency degradation and the efficiency enhancement provided by light concentration mechanisms. As a third objective, students can explore how the color of incident light affects the PV output power, considering the quantum nature of light and its interaction with the PV system.

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