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Effectivity of STEAM Education in Physics Learning and Impact to Support SDGs

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ABSTRACT

Objective: *This study aims to identify trends, visualize trend mapping, document sources, types, and determine which countries contribute the most, identify top authors, and explore opportunities for STEAM-based physics learning publications in improving SDG 4 in educational research.* ***Method:*** *This research was conducted using bibliometric analysis and systematic review methods, employing the PRISMA framework to gather relevant data for the discussion. The Scopus database was used, providing data in the form of a CSV file. The analyses were visualized using the VOSViewer application.* ***Results:*** *The data mapping reveals several impactful studies, including: 1) the role of STEAM learning in achieving the 4th sustainable development goal; 2) cell engineering as a contributor to the 13th sustainable development goal; 3) renewable energy sources such as biomass, geothermal energy, steam turbines, and solar energy to support the achievement of SDG 7, as well as the importance of energy efficiency in reducing carbon emissions to contribute to SDG 13. The most common source type identified is journals, with 83 publications, while articles represent the predominant documented type with 67 publications. The United States stands out as the leading country, contributing 42 publications. Additionally, the top authors identified in this study are Hsiao, P.W. and Su, C.H., with a total of 39 citations.* ***Novelty:*** *This research is novel because it specifically evaluates the STEAM learning model's effectiveness in enhancing SDG 4 within the context of physics education.*

INTRODUCTION

The development of technology has ushered in the era of globalization, causing significant changes across various domains, particularly in education (Sjöström et al., 2023; Baatouche et al., 2022). Many learning models are now being developed to meet contemporary needs, including those that integrate Internet of Things (IoT) technology and emphasize the importance of adequate infrastructure (Miranda et al., 2021). Key fields closely associated with these technological advancements include science and engineering (Hubers et al., 2022; Haleem et al., 2022). In particular, science education, and physics, in school settings are interconnected with technology, engineering, and mathematics, making the STEM (Science, Technology, Engineering, and Mathematics) learning model a suitable approach (Aulyana & Fauzi, 2023; Sulaiman et al., 2022). Implementing STEM learning in educational practices is crucial, as it has been shown to enhance motivation, improve communication skills, and boost self-confidence among students (Murphy & Kelp, 2023).

The limitations of STEM learning have highlighted the need to evolve this model into STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning (Razi & Zhou, 2022; Yang, 2023; Gavari-Starkie et al., 2022). Notably, STEM education may not cater to all students effectively and often lacks elements of creativity, innovation, curiosity, and self-motivation (Razi & Zhou, 2022). The inclusion of 'art' in the STEAM

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