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Implementation of the Masterclass methodology and its contributions to high-energy physics experiment outreach through pattern and track recognition performed by students aged 15 to 17.

This research aimed to investigate how secondary school students identify fundamental particles of the Standard Model through pattern and track analysis in open data from the ATLAS experiment, with additional reference to the DUNE experiment. An initial survey was applied to 57 students (aged 15–17) from two public schools in Bogotá, Colombia. One of the classes was selected as an experimental group comprising 25 students to participate in an independent masterclass. The session featured outreach activities centered on ATLAS open experimental data, utilizing event-display images generated by the HYPATIA software along with simulated particle collision videos—activities that contribute to High Energy Physics (HEP) outreach, a post-assessment applied to the experimental group revealed statistically significant progress in conceptual understanding compared to baseline responses. Quantitative data analysis confirmed this advancement, validated by a high normalized Hake gain (⊠), demonstrating substantial conceptual growth relative to the initial baseline. These findings suggest that a visual pattern recognition and particle tracks provides a highly viable and effective strategy for teaching modern physics in public school environments. Furthermore, this approach significantly contributes to HEP experimental outreach and aids in inspiring new scientific vocations in the region.

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