One-Day High Energy Physics school

Hao-Ren Jheng[1*], Chia-Ming Kuo[1]

[1]*National Central University, Center of High-energy and High-field Physics, Jhongli, Taiwan*
**email: haorenjheng21@gmail.com*

Abstract: The initiative of the One-Day High Energy Physics (HEP) school is to engage the high school students in particle physics. In the school, we designed the structure and material that emphasizes the core competencies such as creativity, independent thinking, and ability in practical problem solving. In this proceeding, we give a brief introduction to the course content, followed by an analysis of students' feedbacks.

Keywords: One-Day HEP Physicist, 一日高能物理學家高中生研習營

1. Introduction

In the latest 108 course guideline, announced by the Ministry of Education, competency-oriented education is of the utmost importance [1]. The educational principle is to motivate creativity, independent thinking, and ability in practical problem solving. According to the guideline, we designed four courses, Introduction of High Energy Physics (HEP), Rolling with Rutherford, DIY cloud chamber, and Data analysis with LHC opendata. The courses and corresponding orientations in the 108 course guideline are shown in Table 1[1].

課程	課程內容	在108課綱中對應的學習內容
拉塞福散射實驗模擬 Rolling with Rutherford	• 拉塞福散射實驗概念 • 實驗記錄與觀察 • 物理實驗和數學模型的連結 • 直接量測與間接量測	• 拉塞福原子模型、原子與原子核的相對大小 (物理、化學) • 機率 (數學) • 基本統計、統計圖表製作和識讀 (數學) • 應用數學方法，解決相關學科問題
DIY雲霧室 (Cloud chamber)	• 雲霧室簡史及其運作原理 • 實作實驗器材 • 利用實驗器材觀察現象	• 帶電粒子在磁場中的運動模式 (此不在108課綱之學習內容，屬進階概念) • 圓周運動及向心力 (物理) • 向量 (屬108課綱數學學科之學習內容)，及向量的外積和其幾何意義 (不在108課綱之學習內容內，屬進階概念)
高能物理實驗簡介及基本數據分析	• 粒子物理發展簡史 • 四大作用力 • 基本粒子的介紹、粒子的衰變 • 大強子對撞機 (Large Hadron Collider, LHC) 簡介及大型粒子探測器的實驗計畫 • 使用開放數據 (opendata) 進行基本數據分析	• 現代物理的發展-基本交互作用 (物理) • 三角函數中正弦sin及餘弦cos的概念 (數學) • 向量的加法及向量的分量 (數量)

Table 1. The courses in the school and corresponding orientations in the 108 course guideline.

We created a detailed questionnaire to collect students' responses. In the questionnaire, we asked students to give a quantitative evaluation of their interests in each course and the difficulty of each course in their opinions, a short paragraph describing their experiences, and how likely they would recommend the school to their friends. An analysis of these responses gave us an insight into the correlation between students' learning interests and course materials.

2. Analysis

From the questionnaire, we gathered a set of 13 variables and performed a simple and quantitative analysis

[1] The contents in Table 1 are written in Traditional Chinese in order to retain the original meaning of 108 course guideline as published by the Ministry of Education.

using Python. Fig. 1 shows how much students were interested in each session and how difficult each session was in their opinions. DIY Cloud chamber, which involved a relatively huge amount of hands-on activities, was students' favorite course. Data analysis with LHC opendata, in which students needed to carry out a successive series calculation, was the most difficult course and got the least interest from students.

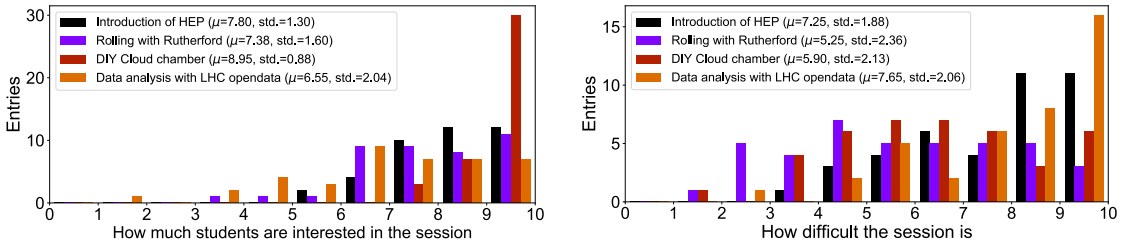

Fig. 1. Students' responses in how much they were interested in each session (left) and how difficult each session was to them (right).

In addition, we calculated Pearson's correlation coefficients between 13 variables. A map of correlation coefficients is shown in Fig. 2. Interestingly, the interest and difficulty in students' opinions of the course Introduction of HEP were negatively correlated, as opposed to such a relation in the other three courses. Secondly, students' interests in the course Introduction of HEP was highly correlated with their interests in the course Data analysis with LHC opendata. Lastly, students' interests in the course Introduction of HEP was highly correlated with their interests to participate in more advanced HEP-related courses and how likely they would like to recommend the school to their friends.

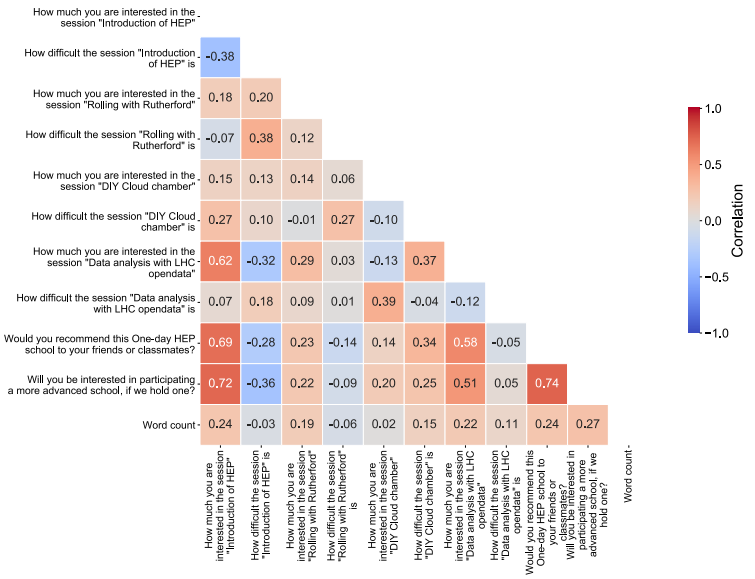

Fig. 2. A map of Pearson's correlation coefficients between 13 variables gathered from students' feedbacks.

3. Conclusions

We organized One-Day HEP schools, the first HEP-related popular science education activity in Taiwan, to inspire high school students to appreciate the beauty of particle physics. With students' feedback, we hoped to gain insights into how students would be interested in a course and to contribute to the popularization of HEP.

References

[1] 十二年國民基本教育課程綱要-國家教育研究院